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WEATHERIZATION TECHNICAL MANUAL

1988

COMMONWEALTH OF MASSACHUSETTS

EXECUTIVE OFFICE OF COMMUNITIES AND DEVELOPMENT

GOVERNMENT DOCUMENTS
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WEATHERIZATION ASSISTANCE PROGRAM
TECHNICAL MANUAL

April 1, 1988

Third Revision

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IMPORTANT DEFINITIONS

"Completed Dwelling Unit"	A dwelling unit is not completed and must not be submitted to EOCD/OEC for production credit until all the applicable weatherization measures have been adequately addressed or until all available WAP funds for that unit have been expended. Also, no dwelling unit may be reported to EOCD/OEC as completed until the subgrantee has performed a fully documented final inspection of the dwelling unit and certified that the applicable work has been completed in a professional manner.
"Incidental Repairs"	A maximum of $500 (material and labor) per unit may be expended on repairs which are necessary for the effective performance or preservation of an allowable energy conservation measure. The maximum repair expenditure of $500 is in addition to the $2,000 maximum for allowable energy conservation materials and labor.
"Allowable Energy Conservation Materials"	Only weatherization materials which appear in Appendix A and meet or exceed the applicable standard shall be purchased with program funds.
"Allowable Energy Conservation and Repair Labor"	Subgrantees may only pay for the installation of allowable weatherization materials or repairs with program funds.

APPENDIX A

STANDARDS FOR WEATHERIZATION MATERIALS

EFFECTIVE APRIL 1, 1988

THERMAL INSULATING MATERIALS FOR BUILDING ELEMENTS INCLUDING WALLS, FLOORS, CEILINGS, ATTICS AND ROOFS

	STANDARDS
Insulation: Mineral Fiber	
Blanket/Batt	Conformance to ASTM[1] C665-78
Roof Insulation	Conformance to ASTM C726-81
Loose-Fill	Conformance to ASTM C764-73 (1979)
Insulation: Mineral Cellular	
Vermiculite Loose-Fill	Conformance to ASTM C516-80
Perlite Loose-Fill	Conformance to ASTM C549-81
Cellular Glass Block	Conformance to ASTM C552-79
Perlite Board	Conformance to ASTM C728-82
Insulation: Organic Fiber	
Cellulosic Fiber Board	Conformance to ASTM C208-82
Cellulose Loose-Fill	Conformance to Interim Safety Standard 16 CFR[2] Part 1209 HH-I-515D
Insulation: Organic Cellular	
Preformed Block-Type Polystryrene	Conformance to ASTM C578-83
Rigid Preformed Urethane Board	Conformance to ASTM C591-69
Polyurethane or Polyiosocyanurate Board Faced With Aluminum Foil	Conformance to F.S.[3] HH-I-1972/1
Polyurethane or Polyiosocyanurate Board Faced With Felts	Conformance to F.S. HH-I-1972/2
Insulation: Composite Board	
Mineral Fiber and Rigid Cellular Polyurethane Composite Board	Conformance to ASTM C726-81
Perlite and Rigid Cellular Poly-Urethane Composite Board	Conformance to ASTM C984-83
Gypsum Board and Polyurethane or Polyisosyanurate Composite Board	Conformance to F.S. HH-I-1972/4
Materials Used As A Patch To Reduce Infiltration Through The Building Envelope	Commercial Availability

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1. ASTM indicates American Society for Testing and Materials.
2. CFR indicates Code or Federal Regulations.
3. F.S. indicates Federal Specification.

THERMAL INSULATING MATERIALS FOR PIPES, DUCTS, AND EQUIPMENT SUCH AS BOILERS AND FURNACES

	STANDARDS	
Insulation: Mineral Fiber		
Preformed Pipe	Conformance to ASTM[1]	C547-77
Blanket and Felt (Industrial Type)	Conformance to ASTM	C553-70
Blanket Insulation and Blanket Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type)	Conformance to ASTM	C592-80
Block and Board	Conformance to ASTM	C612-77
Spray-Applied Fibrous For Elevated Temperature	Conformance to ASTM	C720-72 (1979)
High Temperature Fiber Blanket	Conformance to ASTM	C892-78
Duct Work	Conformance to ASTM	C971-82
Insulation: Mineral Cellular		
Diatomaceous Earth Block	Conformance to ASTM	C517-71 (1979)
Calcium Silicate Block and Pipe	Conformance to ASTM	C533-80
Cellular Glass Block and Pipe	Conformance to ASTM	C552-79
Expanded Perlite Block and Pipe	Conformance to ASTM	C610-67 (1974)
Insulation: Organic Cellular		
Preformed Flexile Elastomeric Cellular in Sheet and Tubular Form	Conformance to ASTM	C534-77
Rigid Preformed Cellular Urethane	Conformance to ASTM	C591-69

---

1. ASTM indicates American Society for Testing and Materials.

FIRE SAFETY REQUIREMENTS FOR THERMAL INSULATING MATERIALS ACCORDING TO INSULATION USE

	STANDARDS
Attic Floor.	Insulation materials intended for exposed use in attic floors shall be capable of meeting the same flammability requirements given for cellulose insulation in 16 CFR[1] Part 1209.
Enclosed Spaces	Insulation materials intended for use within enclosed stud or joist spaces shall be capable of meeting the smolding combustion requirements in 16 CFR Part 1209.
Exposed Interior Walls & Ceilings	Insulation materials, including those wth combustible facings, which remain exposed and serve as wall or ceiling interior finish shall have a flame spread classification not to exceed 150 per ASTM[2] E84.
Exterior Envelope Walls and Roofs	Exterior envelope walls and roofs containing thermal insulations shall meet applicable building code requirements for the complete wall or roof assembly.
Pipes, Ducts, and Equipment	Insulation materials intended for use on pipes, ducts, and equipment shall be capable of meeting a flame spread classification not to exceed 150 (per ASTM E84).

---

1. CFR indicates Code of Federal Regulations.
2. ASTM indicates American Society for Testing and Materials.

STORM WINDOWS

	STANDARDS
Exterior Storm Windows	
Aluminum Combination Unit	Conformance to ASI/AAMA[1] 1002.10-83.
Aluminum Frame	Conformance to Sections 1.2, 1.3, 1.4, and 1.6 of ANSI/AAMA 1002.10-83.
Wood Frame	Conformance to Section 3 of ANSI/ NWMA[2] 1.S. 2-80.
Rigid Vinyl Frame	Conformance to Sections 6.1 through 6.7; 6.12 and 6.13 of ASTM[3] D4099-82.
Frameless Plastic Glazing	Required minimum thickness 6 mil (0.006 inches) basement windows only.
Moveable Insulation Systems for Windows	Commercial Availability
Interior Storm Windows	A demonstrated five (5) year effective life expectancy with a rigid frame.

---

1. ANSI/AAMA indicates American National Standards Institue/Architectural Aluminum Manufacturers Association.

2. ANSI/NWMA indicates American National Standards Institute/National Woodwork Manufacturers Association.

3. ASTM indicates American Society for Testing and Materials.

REPLACEMENT WINDOWS

STANDARDS

Replacement Windows

Aluminum Frame	Conformance to ANSI/AAMA[1] 302.9-1977.
Steel Frame	Conformance to Steel Window Institute Recommended Specifications for Steel Windows 1983.
Wood Frame	Conformance to ANSI/NWMA[2] I.S.2-80.
Rigid Vinyl Frame	Conformance to ASTM[3] D 4099-82.

NOTE: Sealed insulated glass units shall be warranted against failure of the seal for a period of at least ten (10) years.

Replacement windows other than wood must have a built in thermal break.

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1. ANSI/AAMA indicates American National Standards Institute/Architectural Aluminum Manufacturers Association.

2. ANSI/NWMA indicates American National Standards Institute/National Woodwork Manufacturers Association.

3. American Society for Testing and Materials.

REPLACEMENT DOORS

	STANDARDS
Replacement Doors	
Hinged Doors	
o Steel	Conformance to SDI[1] 100-83.
o Wood	
- Flush	Conformance to exterior door provisions of ANSI/NWMA[2] 1-80 Series.
- Pine	Conformance to ANSI/NWMA 1.S. 5-83.
- Fir, Hemlock, Spruce	Conformance to FHDA[3]/7-79.
Sliding Glass Doors	
- Aluminum	Conformance to ANSI/AAMA[4] 4029-1977.
- Wood	Conformance to ANSI/NWMA 1.S. 3-83.

---

1. SDI indicates Steel Door Institute.

2. ANSI/NWMA indicates American National Standards Institute/National Woodwork Manufacturers Association.

3. FHDA indicates Fir and Hemlock Door Association.

4. If multiple glazing is used, sealed insulating glass units are preferred and should conform to ASTM E 774-81. "Standards Specifications for Sealed Insulating Glass Units."

CAULKS AND SEALANTS

	STANDARDS
Caulks and Sealants	Minimum 10-year life.
Putty	Conformance to F.S.[1] TT-P-00791B.
Glazing Compound	Conformance to ASTM[2] C669-75 (1981).
Acrylic (Solvent Type)	Conformance to F.S. TT-S-00230C.
Butyl Rubber	Conformance to F.S. TT-S-001657.
Chlorosulfonated Polyethylene	Conformance to F.S. TT-S-00230C.
Elastomeric Joint Sealants (Normally considered to include polysulfide, polyurethane, and silicone)	Conformance to ASTM C920-79.
Preformed Gasket and Sealing Materials	Conformance to ASTM C509-79.

Backer Rod, Oakum, Untreated Jute, Natural Fiber Twine, Synthetic Twine, or other suitable material. . . commercial availability.

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1. F.S. indicates Federal Specification.

2. ASTM indicates American Society for Testing and Materials.

WEATHERSTRIPPING

	STANDARDS
Weatherstripping.	Must be permanently installed with fasteners (tacks, staples, brads, etc.) and must have a demonstrated life expectancy of at least five (5) years. All V-strip weatherstripping must be of the pre-molded type.

VAPOR BARRIERS

	STANDARDS
Vapor Barrier	Selected according to the provisions cited in ASTM[1] C755-73 (1979); permeance not greater that 1 perm when determined according to the desiccant method described in ASTM E96-80.
Items to Improve Attic Ventilation. . . .	Commercially available.

SKIRTING

Skirting.	Commercially available

---

1. ASTM indicates American Society for Testing and Materials.

CLOCK THERMOSTATS

	STANDARDS
Clock Thermostats	Conformance to NEMA[1] DC 3-1978 or NEMA DC 15-1979 and performance test requirements.[2]

THERMOSTAT CONTROL SYSTEMS

	STANDARDS
Automatic Set-Back Thermostats.	Listed by Underwriters Laboratories (U.L.).
Line Voltage or Low Voltage Room Thermostats	NEMA DC 3-1978.
Hydronic Boiler Control	Commercial availability.

---

1. NEMA indicates National Electrical Manufacturers Association.

2. The performance tests requirements are (1) the operating differential should not exceed 2çF, and (2) the effective operating droops should not exceed 4çF when determined according the applicable procedures in DC 3-1978 or DC 15-1979.

WATER HEATER MODIFICATIONS

	STANDARDS
Insulate Tank and Distributing Piping.	(See Insulation Standards).
Hot Water Pipe Heater Strips.	Listed by Underwriters Laboratories (U.L.).
Reduce Thermostat Settings.	State or local recommendations.
Install Vent Damper, Gas Fueled	ANSI Z21.68-1978. ANSI Z21.67, including Addendas A and B. ANSI Z223.1-1980.
Water Faucet Aerators	Commercially available.
Low Flow Shower Heads	Commercially available. Not to exceed 2.5 Gallons Per Minute (GPM).

BOILER REPAIR AND MODIFICATIONS/EFFICIENCY IMPROVEMENTS

	STANDARDS
Replacement Oil Burner	ANSI Z96.2 (UL 296). ANSI Z91.2. NFPA 31-1983. Commonwealth of Massachusetts Approved.
Gas Power Burners	Conformance to ANSI Z223.1 National Fuel Gas Codes; ANSI Z83.1 Gas Installation.
Furnaces, Oil	Installation of oil burning equipment, NFPA 31-1976.
Furnaces, Gas	Gas-fired, central furnaces, ANSI Z21.47-1978.
Re-adjustment Boiler Water Temperature or Installation of Automatic Boiler Temperature Reset Control	ANSI/ASME CSD.1-1982 applicable section of ANSI Z223.1-1980 and NFPA 31-1983.
Boilers	Boiler and pressure vessel code (eleven sections) ASME 1980 or latest Testing and Ratings Hydronics Institute (HYDI).
Cleanout/Tune-Up	Per EOCD/OEC Guidance.
Combustion Chambers	Refractory linings may be required for conversions. Conformance to NFPA 31-1983.
Thermostatic Radiator Valves	Commercially available. One pipe steam system require steam air vents on each radiator, see manufacturer requirements.
Electronic Ignition System	ANSI Z21.71-1981 installed only with a replacement furnace or boiler.

HEATING SYSTEM REPAIRS AND TUNE-UPS/EFFICIENCY IMPROVEMENTS

	STANDARDS
Duct Insulation	Conformance to FS HH-I-558B. (See Insulation Sections.)
Oil-Fired	Conformance to NFPA 31-1983, Standard for the installation of Oil Burning Equipment.
Gas Fueled Heating Systems, Vent Dampers	Conformance with applicable sections of the Massachusetts Fuel Gas Code. ANSI Z21.66-1977 and addenda A and B for Thermally Activated Vent Dampers.
Reduced Excess Dilution Air Adjustments of Barometric Draft Regulator for Oil Fuels	NFPA 31-1980 for Air Fueled and per manufacturers' (furnace or burner) instructions.
Readjustment of Fan Switch on Forced Air Gas or Oil Fueled Furnaces.	In conformance with applicable sections ANSI Z223.1-1980 Appendix H for Gas Furnaces and NFPA 31-1983 for Oil Furnaces.
Air Ducts and Connectors.	Factory made air ducts and connectors (1981), UL 181.

Massachusetts Energy Conservation Code Section 2010.8. All air handling duct work and plenums shall be constructed and erected in accordance with the appropriate Sheet Metal and Air Conditioning Contractors National Association (SMACNA) Standards.

ALLOWABLE ENERGY CONSERVATION MATERIAL WAIVERS

The following energy conservation material waivers provide for the only opportunity a subgrantee has to expend more than $750 in allowable energy conservation materials money in an eligible WAP dwelling unit. No other energy conservation material waiver or condition exists which would authorize an energy conservation material expenditure level in excess of $750. This is exclusive of repair funds.

NOTE: Waivers #1 & 2 are not applicable if the burners are installed under the HEARTWAP or MWAP Heating System programs.

MATERIAL WAIVER #1:

An increase in the maximum energy conservation materials cost per unit by up to $200, but not to exceed $950, on all dwelling units in which a replacement gas power burner is installed in accordance with guidance provided by EOCD/OEC.

MATERIAL WAIVER #2:

An increase in the maximum energy conservation materials cost per unit by up to $200, but not to exceed $950, on all dwelling units in which a replacement oil burner is installed in accordance with guidance provided by EOCD/OEC.

MATERIAL WAIVER #3:

An increase in the maximum energy conservation materials cost per unit by up to $200, but not to exceed $950, on an eligible dwelling unit when an ineligible unit is weatherized in the same building under the 2 & 4-family 50% and the 66% rules. Example: a 4-family building with 2 units eligible and 2 units ineligible and the 2 ineligible units are receiving assistance, the maximum amount of material funds which may be spent on the entire building would be $750 + $750 + $200 + $200 = $1,900.

Under no circumstances may an eligible dwelling unit receive more than one material waiver or expend more than $950 in allowable weatherization materials.

STATE: MASSACHUSETTS EFFECTIVE DATE: April 1, 1988

ALL WEATHERIZATION MEASURES ARE MANDATORY IN ORDER OF PRIORITY

BUILDING WITH A CONDITIONED BASEMENT* Job Book Reference No. MA-1

Priority	Source of Heat Loss	Weatherization Measure Required
1	Major General Heat Waste	See Manual
1a	Primary Heating System	Heating System Guidance/HEARTWAP
2	Uninsulated Attic (R-11 or less)	ADD to R=30; Electric Heat R=38
3	Uninsulated Walls	ADD R=13
4	Uninsulated Perimeter	ADD R=5
5	Single Glass Windows	ADD Storm Windows
6	Uninsulated Space Heating Pipes and Ducts	ADD Pipe and Duct Wrap
7	Partially Insulated Attic (R-12 to 19)	Insulate to R=30; Electric Heat R=38
8	Minor General Heat Waste	See Manual

BUILDING WITH AN UNCONDITIONED BASEMENT OR CRAWL SPACE Job Book Reference No. MA-2

Priority	Source of Heat Loss	Weatherization Measure Required
1	Major General Heat Waste	See Manual
1a	Primary Heating System	Heating System Guidance/HEARTWAP
2	Uninsulated Attic (R-11 or less)	ADD to R=30; Electric Heat R=38
3	Uninsulated Floors	ADD R=19
4	Uninsulated Space Heating, Domestic Water Pipes and Warm Air Ducts	ADD Pipe and Duct Wrap
5	Uninsulated Walls	ADD R=13
6	Single Glass Windows	ADD Storm Windows
7	Partially Insulated Attic (R-12 to 19)	Insulate to R=30; Electric Heat R=38
8	Minor General Heat Waste	See Manual

MOBILE HOME Job Reference No. MA-3

Priority	Source of Heat Loss	Weatherization Measure Required
1	Major General Heat Waste	See Manual
1a	Primary Heating System	Heating System Guidance/HEARTWAP
2	Uninsulated Floors	ADD R=19
3	Uninsulated Ducts	ADD Duct Wrap
4	Single Glass Windows	ADD Storm Windows
5	Unskirted Perimeter	Install or Repair Skirting
6	Minor General Heat Waste	See Manual

*A conditioned basement is one where useable heat is present either by design or as a result of heating system losses.

MAJOR GENERAL HEAT WASTE

The Major General Heat Waste category is Priority #1 for all housing types and includes the following mandatory weatherization measures which must be complete, if applicable, before advancing to any subsequent priority item.

- Weatherstripping very loose or drafty prime windows*
- Weatherstripping doors
- Interior caulking and sealing (gross air leakage)
- Exterior caulking and sealing to protect the structure against moisture penetration
- Taping warm air duct work joints
- Sill insulation (faced R-11 fiberglass)
- Electrical outlet/switch gaskets
- Glass replacement/glass patch
- Window locks/door locks
- Hot water heater insulation plus the first 6' of domestic hot water pipe
- Fireplace damper

*Recent research has found that windows account for only a small proportion of infiltration in residential buildings.

MINOR GENERAL HEAT WASTE

The Minor General Heat Waste category is a list of additional measures which may be implemented upon the completion of all other applicable energy conservation measures.

- Weatherstripping Loose or Drafty Prime Windows
- Interior Caulking and Sealing
- Low Flow Showerheads
- Water Faucet Aerators
- Reflective Foil Behind Radiators
- Domestic Hot Water Pipe Insulation
- Pulley Seals

WEATHERSTRIPPING

1. **Requirements:**

   Windows: All very loose or drafty movable prime windows which separate conditioned from unconditioned space must be weatherstripped by utilizing a permanent weatherstripping product.

   Doors: All doors which lead from a conditioned to an unconditioned space, such as basements, attics, or hallways are to be effectively weatherstripped.

2. **Material Standards:**

   Although the DOE sets the standard for weatherstripping at "commercial availability", the Office of Energy Conservation requires the installation of a permaneent weatherstripping product which has a minimum effective life of five (5) years.

3. **Recommendations:**

   Doors: Rigid metal or wood with a flexible vinyl weatherstrip for those doors which are subjected to the weather and to temperature extremes. Felt stick or wood and vinyl for those doors which are "interior" to the dwelling unit.

   Windows: Vinyl premolded v-strip or spring metal for double-hung-type windows and gasket-type weatherstrip for metal basement windows. Adhesive backed weatherstripping must be stapled or tacked in place. Stationary for fixed windows must be thoroughly caulked.

NOTE: Windows can often be tightened most efficiently simply by adjusting the stops and installing a good sash lock. Side locks are also an efficient alternative.

INTERIOR CAULKING AND SEALING

EOCD/OEC policy regarding infiltration and exfiltration is to reduce the greatest amount of air leakage in the most cost-effective manner. Air sealing is a systematic and comprehensive approach to stopping up the cracks and holes which allow for uncontrolled infiltration and exfiltration of air and moisture in homes.

Installation Procedures:

- o Apply caulk in a continuous neat bead.
- o All beads will be tooled after application to ensure adequate adhesion and curing.

A. The major sources of air leakage through the foundation are as follows:

- o Cracks in foundation walls
- o The joint between the foundation wall and the wood frame
- o Windows
- o Exterior doors
- o Service entrances (gas, electricity, etc.)
- o Old openings, such as coal chutes
- o Vents and ducts

NOTE: In addition to air leakage through the foundation, many houses will have air leakage from the basement into the attic via such paths as furnace chimney enclosures and plumbing walls.

B. The major sources of air leakage through floors over unheated spaces are gaps where pipes, ducts, cables, etc. pass through the floor.

C. With respect to exterior walls the following are air leakage problem areas:

- o Doors and windows
- o Gaps between the bottom plate of the wall and the floor
- o Electrical receptacles (switches and outlets)
- o Major cracks and gaps in the drywall or plaster, including the joint between the wall and ceiling
- o Gaps between floor boards where they penetrate the wall

D. The major sources of air leakage through ceilings below unheated attic spaces are:

- o Gaps at the top of partition walls
- o Gaps at the top of exterior walls
- o Various holes through and around electrical receptacles
- o Holes around electrical cables
- o Gaps around vent pipes and plumbing stacks
- o Gaps around chimney
- o Gaps around heating duct runs that penetrate the ceiling
- o Gaps around the attic hatch

E. Air leakage areas common to window installations:

- o Interior trim
- o Window frame and sash
- o Deteriorated glass-to-wood joints and through broken or cracked glass

F. Two points of air leakage are common to doors:

- o Door frame
- o Between the door frame and the surrounding wall

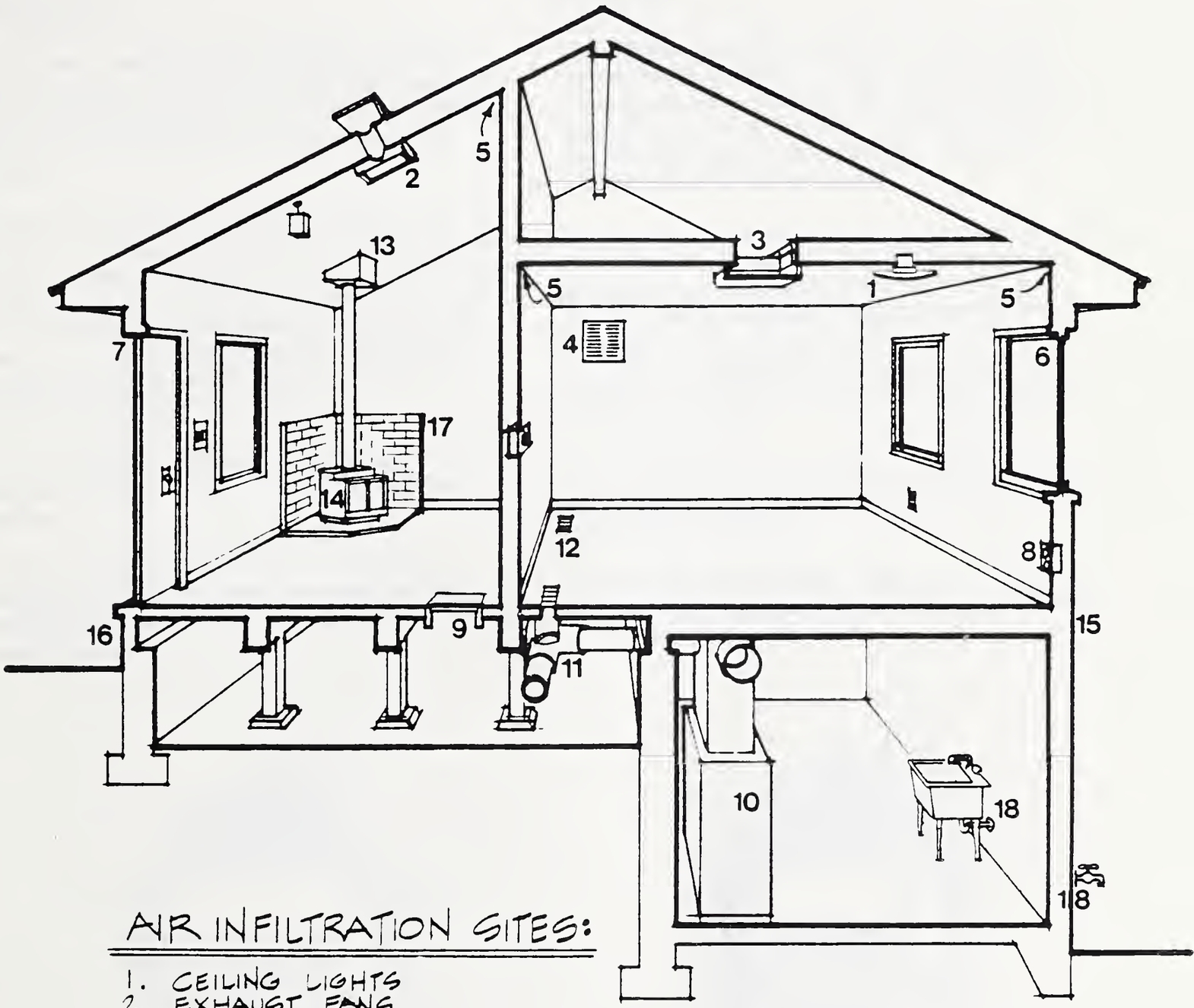
GENERAL NOTES ON AIR SEALING TECHNIQUES

"Fix Big Leaks and Fix Cheap Leaks."

Do major holes in the most important areas first:

1. attic bypasses
2. attic access openings
3. sill plate and foundation
4. open floor joists in kneewall attics
5. other large holes, like broken glass and service entries
6. other leaks outside of the assumed neutral pressure zone
7. chimney chase

Typical Home Air Leakage Sites



AIR INFILTRATION SITES:

1. CEILING LIGHTS
2. EXHAUST FANS
3. ATTIC ACCESS
4. RETURN AIR
5. CEILING CRACKS
6. WINDOWS
7. DOOR OPENINGS
8. ELECTRICAL PENETRATIONS
9. CRAWLSPACE ACCESS
10. FURNACE
11. DUCT JOINTS
12. FLOOR REGISTERS
13. FLUE PENETRATIONS
14. WOODSTOVE DOORS
15. RIM JOIST
16. WALL TO FLOOR CONNECTION
17. WALL TO MASONRY CONNECTION
18. PLUMBING PENETRATIONS

Stack Effect

Let's assume a residence with no fireplaces, no furnace, and no ventilation from kitchen or bath fans of any kind. Let us also assume that, even though there are no heating devices, on this cold winter day it is warm inside the residence.

Because the air inside the residence is warmer than that outside, it is lower in density. Warm air rises, or air that is warmer than the other air around it rises. This creates a pressure difference, with positive pressures in the upper parts of the residence, and negative pressure in the lower parts. As a result, if there are leaks in the envelope, air leakage will occur generally inward at the bottom, and outward at the top.

The taller the residence, the greater this effect. Just as the taller the chimney, the more powerful the draft at the fireplace.

As we'll see, the stack effect means that moisture problems are often concentrated near the top of the residence, since that's where moisture-laden air presses to escape the most.

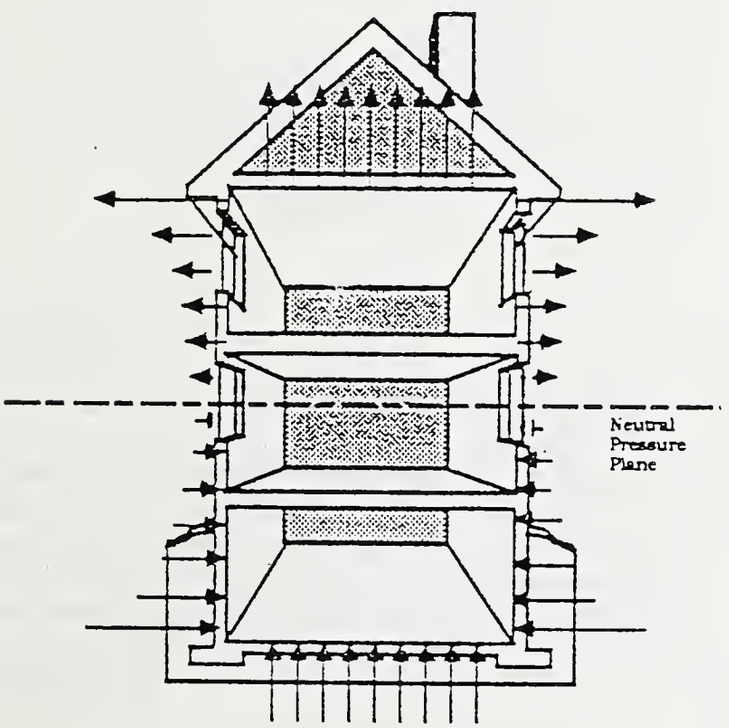
Flue Effect

Flue effects are caused by the same mechanism of heat transfer that causes the stack effect -- convection. Any combustion device -- furnace, boiler, domestic hot water heater, wood stove, or fireplace -- causes a flue effect. The flue effect is a negative pressure on the residence, and therefore causes air leakage inward.

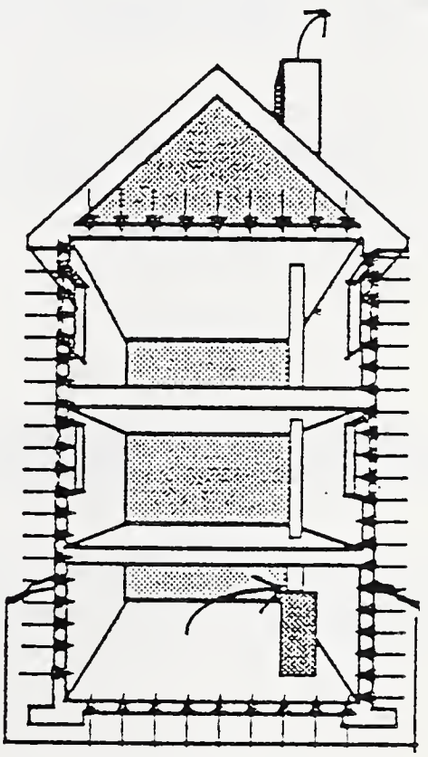
The flue effect is caused by the air requirements and effects of the combustion process. Combustion consumes air, and produces very hot gases, which rise rapidly up the flue. The resulting negative pressure around the flue opening inside the residence, sucking in a lot of air. This is really for two reasons: first, air is required to feed combustion, and second, the stream of air being used for combustion is bringing a lot of other air along with it.

The worst case of this is an open, undamped fireplace. A cozy, blazing fire in a fireplace can pump all the air out of a room every 2 minutes.

There is one type of residence which has no flue effect -- an electrically heated residence which has no fireplaces.



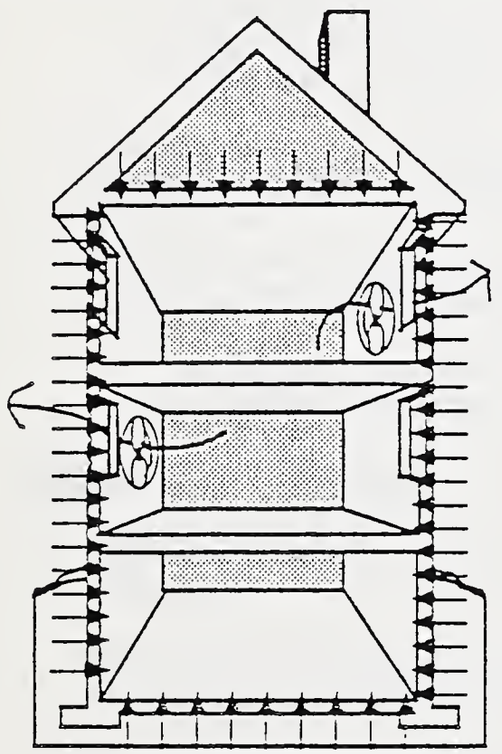
Stack Effect



Flue Effect

Ventilation Effect

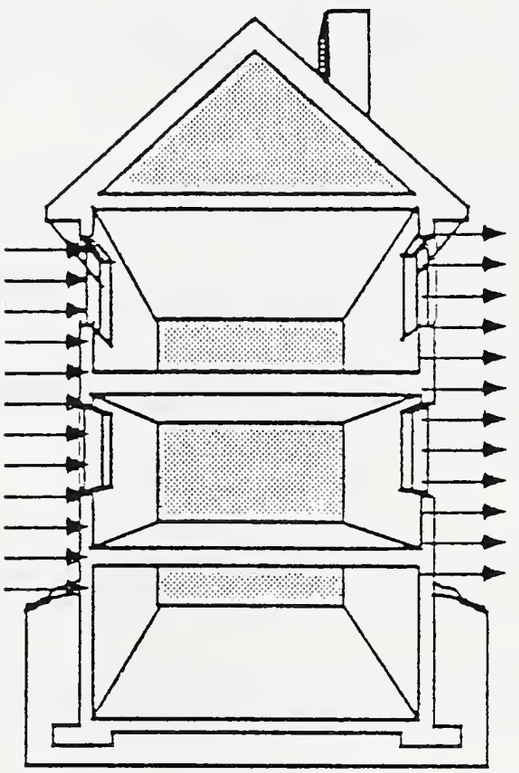
All ventilation systems -- principally kitchen and bath fans -- draw air out of the house without replacing it, thus causing a negative pressure in the residence. There is one exception to this, the air-to-air heat exchanger. You will see this device in newer, very energy-efficient construction where air leakage has been reduced to very low (less than 1/2 ACH) levels. Otherwise, all ventilation devices cause a negative pressure.



Ventilation Effect

Wind Effect

Face into the wind, and you feel a push. What you may not also feel is being pulled from the other side. That is how a residence experiences the wind as well, mostly positive pressures on the upwind sides of the residence, and mostly negative downwind.



Wind Effect

Combined Effects

All of these -- stack, flue, wind, and ventilation effects -- act at the same time on a residence. As already mentioned, an electrically heated residence which has no fireplaces, hot water heaters, wood stoves, or other combustion devices is an exception to this. For all other residences, any of the four effects may be dominant at any one moment, and they are often all acting simultaneously. In general, however, keep these two points in mind as far as the direction of the air movement goes:

1. Air moving <u>out</u> has the potential to carry moisture into the structure and leave it there where it can do damage.

2. In general, air is nearly always moving out through the upper level of a residence, and being replaced from the lower levels.

WATER HEATER INSULATION

1. **Definition:** A material primarily designed to resist heat flow and suitable for wrapping around the exterior surface of the water heater casing.

2. **Requirements and Conditions:**

   A. Always inspect tank to determine type of fuel (oil, gas, electric) and venting requirements.

      1. If an unvented gas unit is found, vent before proceeding with insulation or any other measure and charge the materials to the incidental repairs cost category.

   B. Obtain occupant permission for reducing hot water heater temperature setting to 120° F or 140° F when an automatic dishwasher is present.

   C. Insulate hot water heaters (gas, electric, oil) to a minimum R-5, if it is not a new insulated model.

      1. Use either duct wrap or insulation kits specifically designed for hot water heaters.

3. **Installation Standards:**

   A. Apply the insulation to the water heater with the facing to the outside.

   B. Secure the sections of insulation by stapling or strapping, in addition to, using hi-temperature tape.

   C. Do not install insulation over the water heater operating instructions and other components identified below.

4. **Procedures:**

      1. Electric resistance water heater
         a. Determine the location of pressure relief valve, thermostat control, and hi-limit switch. (See Appendix A, Figure 1.)

      2. Gas-fired water heater
         a. Determine the location of vent damper. Do not insulate gas-fired water heaters so equipped.
         b. Determine the location of the pressure relief valve.
         c. Determine the location of the burner air inlet, pilot light access plate, and drain valve. (Appendix A, Figure 2.)

      3. Oil-Fired water heater
         a. Determine the location of the pressure relief valve, vent pipe, and barometric draft gauge. (Appendix A, Figure 3.)
         b. Determine the location of the thermostat control peep sight and drain valve. (Appendix A, Figure 3.)

A. Electric Resistance Water Heater

1. Install insulation on the sides and top plate.
2. Cut the insulation to leave holes for the pressure relief valve and plumbing pipes.
3. Cut the jacket for access plates.

B. Gas-Fired Water Heater

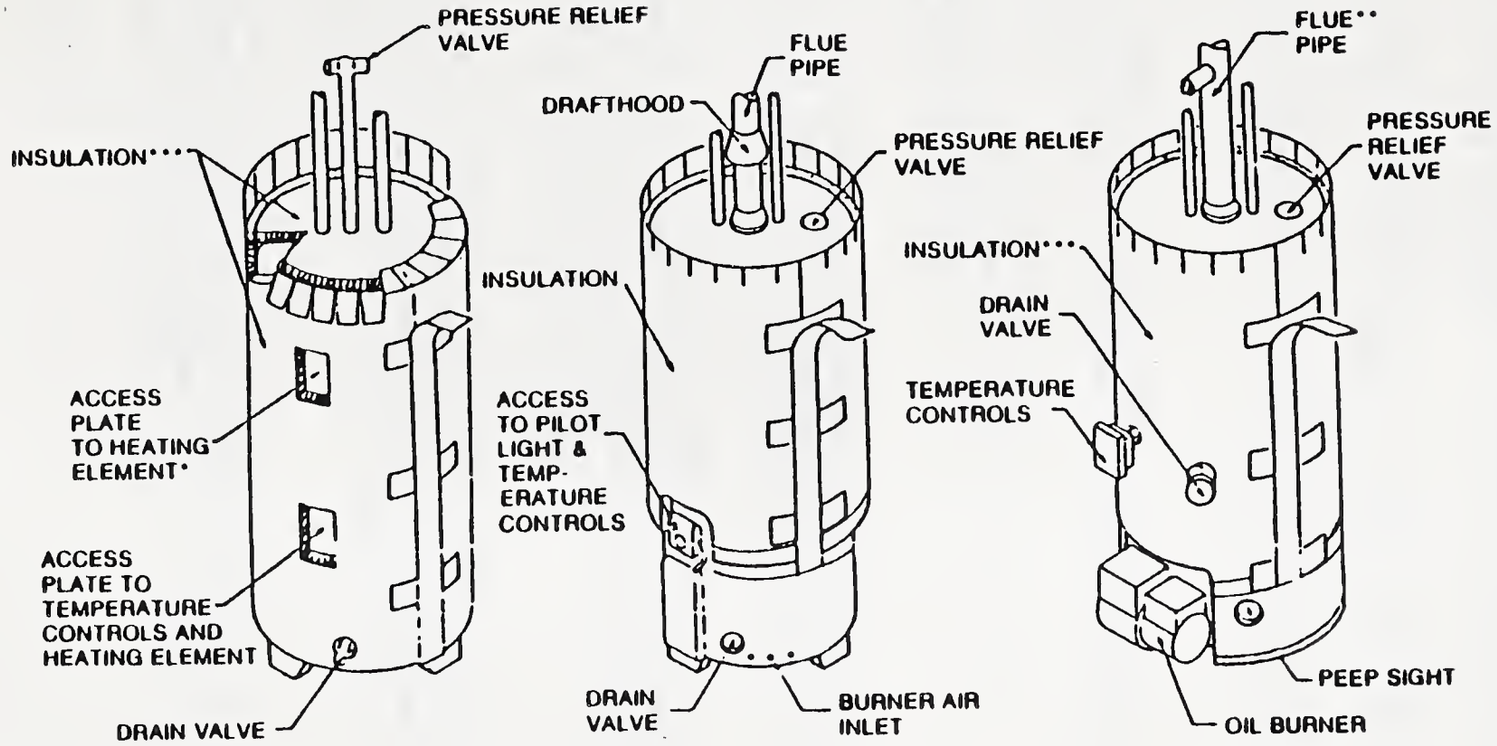
1. Do not install insulation on the top plate.
2. Cut the insulation to leave holes for the burner air inlet, thermostat control, pilot light access plate, drain valve, plumbing pipes and other necessary plates.

C. Oil-Fired Water Heaters

1. If the vent pipe is top-mounted, do not install insulation on the top plate.
2. If the vent pipe is side-mounted, maintain the minimum vent connector clearances specified in the latest edition of NFPA 211, Standard for Chimneys, Fireplaces, and Vents.
3. Cut the insulation to leave holes for the pressure relief valve, thermostat control, flame peep sight, burner access plate, drain valve, plumbing pipes, and other necessary access plates.

D. Post-Installation Procedures

1. Ensure that the insulation is securely attached with staples and duct tape.
2. Ensure that required clearances are maintained around vent pipes; and insulation has not been installed on the top of oil-fired water heaters, which have a top-mounted vent pipe, or gas-fired water heaters.
3. Ensure that air inlets, access plates, drain valves, temperature controls, and pressure relief valves are not covered by insulation, except where otherwise instructed.



Electric Water Heater | Gas-Fired Water Heater | Oil-Fired Water Heater

* Only found on water heaters with two heating elements.

** The pipe may be side-mounted.

*** Top insulated on all electric water heaters and oil-fired water heaters with side-mounted flue pipes.

HEATING SYSTEM WORK

1. All heating system work MUST be supplied through HEARTWAP if the WAP client is federally LIHEAP eligible. No WAP funds may be utilized.

2. If the WAP client is not HEARTWAP eligible then MWAP Heating System funds must be utilized for the allowable heating system work.

3. WAP subgrantees should make arrangements with HEARTWAP Coordinator(s) in your area to set aside sufficient HEARTWAP funds for projected WAP heating system work.

4. All heating system work for the MWAP Heating System program will be based on HEARTWAP technical guidelines and the heating system guidance provided in this manual.

5. The priorities for HEARTWAP funds are as follows:
   a. Weatherization Clients
   b. Emergencies

6. It is still a legitimate, acceptable, and expected expense and activity for a WAP auditor to perform a combustion efficiency test on a client's heating system when he/she is inspecting/auditing the home prior to weatherization.

7. WAP Program Directors bear the responsibility of informing HEARTWAP Program Directors, be they located within the same subgrantee or within a subgrantee whose HEARTWAP service area overlaps the WAP service area, in a weekly referral list that a client's home a) will soon be weatherized and/or, b) is in need of heating system assistance.

8. HEARTWAP Program Directors bear the responsibility of informing WAP Program Directors, be they located within the same subgrantee or within a subgrantee whose WAP service area overlaps the HEARTWAP service area, in a weekly referral list that a client's home will soon be receiving heating system assistance.

9. LIHEAP Program Directors bear the responsibility of providing all WAP and HEARTWAP Program Directors in any subgrantee in its LIHEAP service area in a referral list, with the consent of the LIHEAP client, the weekly or monthly client eligibility list.

HEATING SYSTEM CLIENT FILES

The following is a listing of forms and information which, if applicable, must be in all HEARTWAP and MWAP Heating System client files.

1. Certification of Eligibility
   a. Copy of certified fuel assistance application (federal level), or
   b. LIHEAP application number supported by an available computer printout or escrow sheet.
   c. MWAP heating system clients must be determined as MWAP eligible.

2. Work permits signed by property owner when required. See Appendix A OEC-HW-FY'88-002.

3. Tenant/Landlord Agreement signed by the landlord or their agent and the tenant when required. See Appendix A OEC-HW-FY'88-002.

4. Justification of why the work was performed.
   a. WAP referral along with the WAP auditor's combustion efficiency test results.
   b. No heat calls and repair work stated in writing by the heating contractor.
   c. System replacements with confirmation by another contractor or subgrantee technical staff person.

5. Contractor Invoice
   a. Itemized list of all parts installed and the work which was performed.
   b. Statement as to why the work was required if not previously authorized by the agency.
   c. Combustion efficiency test results for all C/T/E's, burner replacements, system replacements and whenever possible when doing repairs

6. Quality Control Form
   a. Signed and dated by Quality Control Inspector.
   b. Combustion efficiency test results for all quality control visits including minor repairs.
   c. Observations regarding code violations and the overall condition of the heating system.
   d. Notation as to whether the work was acceptable or not, and if not, document the resolution of the problem.

7. Proof of Ownership documentation when the total assistance for the program year exceeds $875.00.

8. Building Permit. Copies of all applicable permit applications or receipts.

9. Heating Assistance Report is to be completed when a client receives a burner replacement, primary heating system replacement or when the total program assistance reaches $300.00 or more.

10. Asbestos Abatement related information. See OEC-HW-FY'88'002.

MASSACHUSETTS EXECUTIVE OFFICE OF COMMUNITIES AND DEVELOPMENT

OFFICE OF ENERGY CONSERVATION

GAS-FIRED HEATING SYSTEM EFFECIENCY MODIFICATIONS

The following guidance was developed for use by operators of the Weatherization Assistance Program in Massachusetts in an effort to provide for more complete and comprehensive weatherization in dwelling units with gas-fired heating systems.

ALLOWABLE MODIFICATIONS TO GAS-FIRED HEATING SYSTEMS

The following adjustments/devices are allowable (both parts and labor) within the maximum allowable cost per dwelling unit as established by the grantee for all WAP subgrantees within the State:

MODIFICATION	ESTIMATE INSTALLED COST	ANNUAL PERCENTAGE OF ENERGY CONSUMPTION SAVED
1. Tune-up & Evaluate	$ 50	5%
2. Vent Dampers		7%
A. Electrical	$ 200	
B. Thermal	$ 100	
3. Clock Thermostat	$ 100	5 to 15%
4. Hydronic Boiler Control	$ 300	10%
5. Power Burner	$ 400	15%
6. Replacement Furnace or Boiler	$ 1,600 to 2,200	

INSPECTION PROCEDURE

The subgrantee's inspector/auditor will view the color of the gas flame. If the flame is yellow instead of blue, or if after performing a combustion efficiency test the steady-state efficiency if below 75%, then a trained licensed serviceman should be brought in to make the necessary adjustments. This preliminary step must be ranked as the #1 priority equal to the reduction of the General Heat Waste.

DEFINITIONS

1. **TUNE-UP & EVALUATE:** Shall include the following measures:

   - Pilot and burner adjustment
   - Adjustment of ventilation and combustion
   - Check and reset controls
   - Inspect filters
   - Lubricate motors
   - Flush low water cut-off (steam)
   - Check operation of steam and water relief valves
   - Check thermostat operation
   - Check safety valve
   - Check thermocouple - replace if necessary
   - Combustion efficiency test

2. **VENT DAMPERS:** An automatically operated damper installed in a designed gas-fired heating system which:

   A. Is installed downstream from the draftwood; and
   B. conserves energy by substantially reducing the flow of heated air through the chimney when the furnace is not in operation.

3. **CLOCK THERMOSTAT:** A device which is designed to reduce energy consumption by regulating the demand on the heating system in which it is installed and uses:

   A. A temperature control device for interior spaces incorporated more than one temperature control level; and
   B. a clock or other automatic mechanism for switching from one control to another.

4. **HYDRONIC BOILER CONTROL:** Automatic boiler temperature reset control allows for using a boiler water temperature which more closely matches the amount of heat needed to maintain comfortable room temperature for a given outdoor air temperature. This controller automatically raises the circulating boiler water temperature set point as outdoor temperature drops, and reduces the water temperature setting in milder weather. Energy is saved due to reduced cycling of the burner, and less heat is lost out the stack during the off period.

5. **POWER BURNER:** A burner in which either gas or air or both are supplied at a pressure exceeding, for gas, the line pressure, and for air, atmospheric pressure; this added pressure being applied at the burner. A burner for which air for combustion is supplied by a fan ahead of the appliance is commonly designated as a forced-draft burner.

   1. Premixing Burner: a power burner in which all or nearly all of the air is mixed with the gas as primary air.

6. **REPLACING FURNACE OR BOILER:** The space heating system which in an eligible dwelling unit provides for the majority of the space heating needs of the residents.

SETTING PRIORITIES ON GAS-FIRED HEATING SYSTEMS

1. **TUNE-UP/EVALUATE:** If the flame is yellow instead of blue or if after performing a combustion efficiency test the steady-state efficiency is below 75%, the priority of this measure should rank equal to that of the General Heat Waste category.

2. **VENT DAMPERS:** This modification is to be considered as an alternative and is to be utilized only after the following criteria has been met:

   1. All applicable weatherization measures have been installed and allowable funds remain available; and

   2. a trained, certified and licensed technician has evaluated the system, and determined the following

      a. That the modification does not violate any safety codes or manufacturers recommendations. IMPORTANT: Vent Dampers cannot be installed on conversion gas burners. Install only on designed equipment.

3. **CLOCK THERMOSTAT:** After all applicable measures have been installed and allowable funds are available, this measure should be considered an an alternative. However, no savings will be realized unless the occupant utilizes the device in accordance with its intended purpose.

4. **HYDRONIC BOILER CONTROL:** After all applicable measures have been installed and allowable funds are available, this measure should be considered as an alternative.

5. **POWER BURNER:** This modification should be utilized to replace inefficient (70% or less efficiency after a tune-up/evaluation) unsafe or inoperable atmospheric conversion burners in former oil or coal furnaces or boilers.

6. **REPLACEMENT FURNACE OR BOILER:** If a furnace or boiler is documented to be unsafe or inoperable or if it is a gravity warm air furnace then it should be placed at the top of the priority list.

7. Other allowable heating system measures which, if applicable, must be performed in conjunction with any other necessary heating system modification:

   - Line Voltage or Low Voltage Thermostat (See Thermostat Location)
   - Combustion Chambers: must be rebuilt, relined, replaced or otherwise modified if they are found to be significantly deteriorated or if they are improperly sized. OEC recommends the use of pre-cast mini-combustion chambers and wet chamber lining material.
   - Thermostatic Radiator Valves: provide individual control of radiators, convectors or baseboards in two pipe steam and hot water heating systems. They effectively allow for the balancing of uneven heat distribution systems.
   - Air Ducts and Connectors: should be properly sized and able to deliver heat to the desired areas. Sufficient cold air return should be present, equal to 100% of the warm air distribution.

MATERIAL STANDARDS

CLOCK THERMOSTATS: Conformance to NEMA DC 15-1979 or NEMA DC 3-1978 and Underwriters Laboratories (U.L.)

POWER BURNERS: ANSI Z223.1

HYDRONIC BOILER CONTROL: Commercial Availability

VENT DAMPERS:

Electrically-Operated Automatic Vent Damper: ANSI Z21.66-1978

Thermally-Operated Automatic Vent Damper: ANSI Z21.68-1978

All Gas vent damper manufacturers must be granted approval and all installers must be certified by the Board of State Examiners of Plumbers and Gas Fitters in the Commonwealth of Massachusetts.

REPLACEMENT FURNACE OR BOILER:

- Gas-fired, central furnaces, ANSI Z21.47- 1978
- Boiler and Pressure vessel code (eleven sections) ASME 1980 or latest
- Testing and Ratings Hydronics Institute (HYDI).
- Minimum AFUE Rating of 78%
- Electric Ignition systems are allowable with a replacement furnace or boiler.

COMBUSTION CHAMBERS: NFPA 31-1983

THERMOSTATIC RADIATOR VALVES: Commerical Availability

AIR DUCTS AND CONNECTORS: UL 181

LINE VOLTAGE OR LOW VOLTAGE THERMOSTATS: NEMA DC 3-1978

IMPORTANT: Local, state and federal requirements regulating the handling and removal of asbestos containing materials, and personnel safety/health procedures during retrofit must be followed.

GAS HEAT CTE PROCEDURES

- Check fan belts and blowers
- Check safety controls
- Check barometric damper operation
- Check thermostat operation and location
- Check thermocouple
- Check chimney base and flue pipe
- Adjust pilot and burner
- Inspect and replace filters as necessary
- Lubricate all motors
- Flush and test low water cut-off
- Clean or change water glass
- Clean burner, combustion chamber and heat exchange surfaces
- Complete a post-combustion efficiency test
- Document major code violations

GAS FIRED HEATING SYSTEM QUALITY CONTROL PROCEDURE

1. Check color of flame. A blue flame should be observed. A yellow flame denotes inefficiency.

2. Check for flame stability. The flame should be stationary and not "dancing."

3. Check for unusual noises and vibrations.

4. Check for a defective or misadjusted draft regulator.

5. Take combustion efficiency test on retrofit equipment. No test is necessary on design equipment.

The following combustion efficiency test results are considered acceptable for gas heating systems after a clean-out/tune-up has been performed.

Smoke	0
Net Stack Temperature	300 to 500°F
CO_2	8 to 10%
O_2	5 to 7%
Combustion Efficiency	71 to 82%

If post combustion efficiency test results are found not to be within acceptable parameters, then the attending technician should be required to document the heating system's deficiencies.

BURNER REPLACEMENT PERFORMANCE STANDARD: Gas burners replaced in oil or coal converted boilers or furnaces must attain a minimum combustion efficiency of 75% or the servicing technician must provide the subgrantee with written justification detailing the reasons why this minimum level of efficiency could not be attained.

OEC staff are the only individuals authorized to grant a waiver of this standard.

FURNACE OF BOILER REPLACEMENT PERFORMANCE STANDARDS: Gas-fired furnace or boiler replacements with an atmospheric burner must attain a minimum post-installation combustion efficiency of 75%.

Gas-fired furnace or boiler replacements with a gas power burner must attain a minimum post-installation combustion efficiency of 80%.

MASSACHUSETTS EXECUTIVE OFFICE OF COMMUNITIES & DEVELOPMENT

OFFICE OF ENERGY CONSERVATION

OIL-FIRED HEATING SYSTEM EFFICIENCY MODIFICATIONS

The following guidance was developed for use by operators of the Weatherization Assistance Program in Massachusetts in an effort to provide for more complete and comprehensive Weatherization in dwelling units with oil-fired heating systems.

ALLOWABLE MODIFICATIONS TO OIL-FIRED HEATING SYSTEMS

The following adjustments/devices are allowable (both parts and labor) within the maximum allowable cost per dwelling unit as established by the grantee for all WAP subgrantees within the State:

	ALLOWABLE MEASURES	ESTIMATED INSTALLED COST	ANNUAL PERCENTAGE OF ENERGY CONSUMPTION SAVED
1.	Clean/Tune-up & Evaluate	$ 50	5%
2.	Replacement Oil Burner	$ 350	15%
3.	Clock Thermostat	$ 100	5-15%
4.	Hydronic Boiler Control	$ 300	10%
5.	Replacement Furnace or Boiler	$ 1,600-2,200	25%

DEFINITIONS

1. **TUNE-UP & EVALUATE:** shall include the following measures:

   - Check for oil leaks
   - Check chimney base and flue pipe
   - Check operation of all controls
   - Check pump pressure
   - Check barometric damper operation
   - Check thermostat operation
   - Flush low water cut-off
   - Lubricate all Motors
   - Replace all filters as necessary
   - Clean or change water glass
   - Clean pump strainer and inner housing
   - Replace nozzle
   - Clean electrodes
   - Clean, brush and vacuum boiler and furnace throughly
   - Adjust fuel/air for proper combustion

   Every attempt should be made to optimize the firing rate on oil-fired equipment when possible.

   Combustion efficiency test results, in addition to smoke and draft readings, are required as part of all service calls.

2. **REPLACEMENT OIL BURNER:** a high speed, flame-retention head device which atomizes the fuel oil, mixes it with air and ignites the fuel-air mixture.

3. **CLOCK THERMOSTAT:** a device which is designed to reduce energy consumption by regulating the demand on the heating system in which it is installed and uses:

   A. A temperature control device for interior spaces incorporating more than one temperature control level; and

   B. A clock or other automatic mechanism for switching from one control level to another.

4. **HYDRONIC BOILER CONTROL:** Automatic boiler temperature reset control allows for using a boiler water temperature which more closely matches the amount of heat needed to maintain comfortable room temperature for a given outdoor air temperature. This controller automatically raises the circulating boiler water temperature set point as outdoor temperature drops, and reduces the water temperature setting in milder weather. Energy is saved due to reduced cycling of the burner, and less heat is lost out the stack during the off period.

5. **REPLACEMENT FURNACE OR BOILER:** The space heating system which in an eligible dwelling unit provides for the majority of the space heating needs of the residents.

SETTING PRIORITIES ON OIL-FIRED HEATING SYSTEMS

1. **TUNE-UP/EVALUATE:** If a burner has not been serviced within the current heating season, or if any of the combustion efficiency test results are unacceptable, then this option must be considered no less than priority number 1a.

2. **REPLACEMENT OIL BURNER:** A burner may not be considered for replacement unless (a) a licensed technician states in writing that the existing burner is unsafe or inoperable, or (b) the combustion efficiency of the burner, after a tune-up evaluation, is 70% or less. Under these circumstances, the priority ranking of this option must be equal to priority number 1a.

3. **CLOCK THERMOSTAT:** After all applicable measures have been installed and allowable funds are available, this measure should be considered as an alternative. However, no savings will be realized unless the occupant utilizes the device in accordance with its intended purpose.

4. **HYDRONIC BOILER CONTROL:** After all applicable measures have been installed and allowable funds are available, this measure should be considered as an alternative.

5. **REPLACEMENT FURNACE OR BOILER:** If a furnace or boiler is documented to be unsafe or inoperable or if it is a gravity warm air furnace then it should be placed at the top of the priority list.

6. Other allowable heating system measures which, if applicable, must be performed in conjunction with any other necessary heating system modification;

   - Line Voltage or Low Voltage Thermostat (See Thermostat Location)

   - Combustion Chambers: must be rebuilt, relined, replaced or otherwise modified if they are found to be significantly deteriorated or if they are improperly sized. OEC recommends the use of pre-cast mini-combustion chambers and wet chamber lining material.

   - Thermostatic Radiator Valves: provide individual control of radiators, convectors or baseboards in two pipe steam and hot water heating systems. They effectively allow for the balancing of uneven heat distribution systems.

   - Air Ducts and Connectors: should be properly sized and able to deliver heat to the desired areas. Sufficient cold air return should be present, equal to 100% or the warm air distribution.

MATERIAL STANDARDS

CLOCK THERMOSTATS: Conformance to NEMA DC 15-1979 or NEMA DC 3-1978 and Underwriters Laboratories (U.L.)

HYDRONIC BOILER CONTROL: Commercial Availability

REPLACEMENT OIL BURNER: ANSI Z96.2 (UL296)
ANSI Z91.2
NFPA 31-1983
Commonwealth of Massachusetts

REPLACEMENT FURNACE OR BOILER:

- Installation of oil burning equipment, NFPA 31-1976
- Boiler and Pressure vessel code (eleven sections) ASME 1980 or latest Testing and Ratings Hydronics Institute (HYDI).
- Minimum AFUE Rating of 78%

COMBUSTION CHAMBERS: NFPA 31-1983

THERMOSTATIC RADIATOR VALVES: Commercial Availability

AIR DUCTS AND CONNECTORS: UL 181

LINE VOLTAGE OR LOW VOLTAGE THERMOSTATS: NEMA DC 3-1978

OIL HEAT CTE PROEDURES

- Check for oil leaks
- Check chimney base and flue pipe
- Check operation of all controls
- Check pump pressure
- Check barometric damper operation
- Check thermostat operation and location
- Flush low water cut-off
- Lubricate all motors
- Replace all filters as necessary
- Clean or change water glass
- Clean pump strainer and inner housing
- Replace nozzle
- Clean electrodes
- Clean, brush and vacuum boiler and furnace thoroughly
- Adjust fuel/air for proper combustion
- OPTIMIZE THE FIRING RATE. Fire the boiler or furnace at the lowest possible rate to provide adequate heat and, if applicable, hot water
- Complete a post-combustion efficiency test and smoke and draft readings
- Document major code violations

OIL-FIRED HEATING SYSTEM QUALITY CONTROL PROCEDURE

1. **CHECK FOR SOOT**

   Check for soot deposits in the flue, combustion chamber and on the heat exchanger. (It is estimated that a coating of soot 1/8" on the heat exchanger could increase fuel consumption by 25%.)

2. **CHECK FOR UNUSUAL NOISES AND VIBRATIONS**

3. **FLAME IGNITION**

   Check to see if flame ignition is instant or delayed. Flame ignition should be instant.

4. **FLAME COLOR**

   Check flame color, is it orange, yellow, white or with streaks or sparks in the flame? A white flame indicates excessive combustion air. Sparks or streaks indicate poor atomization.

5. **FLAME SHAPE**

   Check for flame shape, a lopsided or distorted flame indicates defective nozzle, poorly adjusted electrodes or a damaged nose cone.

6. **FLAME IMPINGEMENT**

   Check to see if the flame is hitting the sides or back of the combustion chamber (flame should not impinge chamber walls and the flame should fill the chamber).

7. **FLAME CUT-OFF TIME**

   Estimate the number of seconds required for the flame to disappear after the burner shuts down. Not more than three seconds should be required.

8. **DRAFT REGULATOR**

   Check for a defective of misadjusted regulator.

9. **CHECK CHIMNEY**

   Check for any accumulation of soot.

10. **CHECK FOR OIL LEAKS**

11. **TAKE COMBUSTION TEST**

    Take efficiency test and compare with contractor submitted results.

CLEAN-OUT/TUNE-UP PERFORMANCE STANDARDS

The following combustion efficiency test results are considered acceptable for oil-furnace heating system after a clean-out/tune-up has been performed.

Smoke	0 to 1
Net Stack Temperature	300 to 600°
Net Stack Temperature with Flame Retention Burner	300 to 400°
CO 2	8 to 12%
Draft at Breach	-.02 to -.04
Draft over Fire	-.01 to -.02
Combustion Efficiency	71 to 85%

Note: OEC does not consider the use of a "soot stick" to be an acceptable alternative to brushing and vacuuming a furnace or boiler. In fact, the use of a "soot stick" could possibly damage the heat exchange surfaces of a furnace or boiler.

If post combustion efficiency test results are found not to be within acceptable parameters, then the attending technician should be required to document the heating system's deficiencies.

Burner Replacement Performance Standards

Oil Burners replaced in coal converted boilers or furnaces must attain a minimum combustion efficiency of 75% with a trace - 1 smoke or the servicing technician must provide the subgrantee with written justification detailing the reasons why this minimum level of efficiency could not be attained.

Oil Burners replaced in design boilers or furnaces must attain a minimum combustion efficiency of 79% with a trace - 1 smoke or the servicing technician must provide the subgrantee with written justification detailing the reasons why this minimum level of efficiency could not be attained.

OEC staff are the only individuals authorized to grant a waiver of the above standards.

Furnace or Boiler Replacement Performance Standards

Oil-fired furnace or boiler replacements must attain a minimum post-installation combustion efficiency of 80% with a trace - 1 smoke.

HEATING SYSTEM EFFICIENCY REPORT

CLIENT NAME: _____ JOB # _____

☐ Oil-Fired Heating System ☐ Gas-Fired Heating System

INITIAL COMBUSTION EFFICIENCY TEST RESULTS

SMOKE _____

NET STACK TEMPERATURE (°F) _____

CO_2 (%) _____
or
O_2 (%) _____

EFFICIENCY (%) _____

OVERFIRE DRAFT _____

BREECH DRAFT _____

COMMENTS AND OBSERVATIONS

_____

_____

_____

_____

DATE _____

SIGNATURE _____

SERVICE TECHNICIAN'S COMBUSTION EFFICIENCY TEST RESULTS

SMOKE _____

NET STACK TEMPERATURE (°F) _____

CO_2 (%) _____
or
O_2 (%) _____

EFFICIENCY (%) _____

OVERFIRE DRAFT _____

BREECH DRAFT _____

COMMENTS AND OBSERVATIONS

_____

_____

_____

_____

DATE _____

SIGNATURE _____

NOZZLE SIZE

Before _____

After _____

FOLLOW-UP COMBUSTION EFFICIENCY TEST RESULTS

SMOKE _____

NET STACK TEMPERATURE (°F) _____

CO_2 (%) _____
or
O_2 (%) _____

EFFICIENCY (%) _____

OVERFIRE DRAFT _____

BREECH DRAFT _____

COMMENTS AND OBSERVATIONS

_____

_____

_____

_____

DATE _____

SIGNATURE _____

WARM AIR FURNACES; HEAT EXCHANGER FAILURES

The Office of Energy Conservation (OEC) has recently completed research into the issue of premature heat exchanger failure associated with oil-fired warm air furnaces. During the last year the OEC has been made aware of several cases of heat exchangers failing within 1 - 3 years of the system's installation.

After discussing this important issue with a number of burner and furnace manufacturer's (and of course NEFI) it now appears that the cause of heat exchanger failures in warm air furnaces is related to improper oil burner settings by heating system technicians. There exists a direct relationship between high CO_2 and O_2 readings and flame temperature. The higher the CO_2 or the lower the O_2 reading the greater the flame temperature.

Thus, the following standards regarding CO_2 and O_2 readings must be adhered to by all subgrantees when dealing with oil-fired warm air furnaces.

* CO_2 not to exceed 11%
* O_2 not to be lower than 6%

These reduced CO_2 and O_2 readings are for warm air furnaces only, and not hot water and steam boilers, because furnaces cannot withstand the same temperatures that cast iron water backed boilers can.

Please ensure that all staff involved in quality control tasks and heating contractors are made aware of this technical guidance.

THERMOSTAT LOCATION

During the inspection of all dwelling units for weatherization, special attention must be paid to the location of heat regulating thermostats.

The thermostat provides the trigger for starting and stopping space heating equipment in response to temperature changes.

Thus, it is extremely important to ensure that the location of a heat regulating thermostat be placed where it can maintain the proper warm temperature of the dwelling unit. Thermostats should never be located on outside walls, in hallways, close to windows, near radiators, warm air registers or any other heat producing sources.

The best location is usually on the inside wall of a dining or living room and away from any possible air currents.

The relocation of a thermostst, when deemed necessary for the efficient operation of a heating system, is a required measure. It should be performed in conjunction with any necessary heating system modifications.

The replacement of a line or low voltage thermostat, in addition to the installation of a clock thermostat, is an allowable weatherization material expenditure.

All labor costs associated with the installation of an allowable thermostat must be charged to the "contractor labor" category.

ATTIC INSULATION

1. **Definition:** A material or assembly of materials, primarily designed to resist heat flow, which is installed between the conditioned area of a building and an unconditioned attic. Where the conditioned area of a building extends to these roofs, the term attic insulation also applies to material used between the underside of the roof and the upperise of the attic.

2. **Requirements:**

   a. Insulate all finished and unfinished attic areas, where possible, to a settled density of R-30 as recommended by DOE for our region. R-38 S.D. for electrically heated units. To simplify field calculations subgrantees should determine the settled density (S.D.) R-value of loose fill cellulose insulation to be R-3 per inch. Example: R-30 S.D. equals 10" of blown material.

   b. Properly insulate and weatherstrip all attic entryways, such as: scuttle holes (R-19), walkup stairways (R-7), and pulldown stairways (R-7).

   c. Complete and retain on file an Attic Inspection Form for all attic insulation installations.

   d. After completing installation of thermal insulation materials, the crew chief or private contractor responsible for the installation must complete and post a "Certification of Insulation" form.

3. **Procedures:**

   Pre-installation procedures (attic preparation)

   a. Identify all recessed lighting fixtures, including wiring, compartments, and ballasts, vents, chimneys and other heat-producing devices in all areas where insulation is to be installed.

      (1) Block off recessed light fixtures with a sheet metal barrier or any number of products commercially available. Install all blocking at least as high as the height of the finished insulation and in a manner that ensures that all devices which may require maintenance or service remain accessible after the insulation is installed. A three inch minimum clearance between the fixture and the insulation must be maintained. In addition, do not cover recessed light fixtures. It entraps heat and/or prevents the free circulation of air. Massachusetts Energy Conservation Code Section 2006.4.2. High heat sources: A clearance of three (3) inches from any high heat source, including but not limited to chimneys, flues and vents, shall be maintained for combustible insulating materials.

b. Inspect the room, ceiling, and attic floor to identify areas where a previous moisture problem caused paint peeling, warpage, stain, visible fungus growth, rotting or other structural damage. Do not install insulation in such areas until the resident is informed and these conditions are corrected and their sources eliminated.

c. Determine if knob and tube wiring is present (see knob and tube wiring guidance).

d. Install permanent blockings to restrain loose-fill insulation from clogging soffit vents at the eaves restricting attic ventilation. Install permanent blocking to ensure free movement of air through soffit vents into the attic, to achieve a uniform R-value and complete coverage.

e. Cover wall and drop ceiling cavities to prevent filling these areas with cellulose.

VENTILATION REQUIREMENTS

Do not install insulation in an attic space unless adequate and permanent ventilation is installed.

Adequate cross-ventilation shall be maintained above all attic insulation by providing both low and high vents or gable end vents. One square foot of net-free vent area shall be provided for every 300 ft^2 of attic area with 50 to 60% of the vent area located near the roof ridge and 40 to 50% located near the eaves. One level of venting may be used provided that adequate cross ventilation can be maintained. When only one level of venting is used, 1 ft^2 of net-free area shall be provided for every 150 ft^2 of ceiling area.

The energy auditor must specify the type number, and location of all vents to the contractor.

NOTE: Although the use of window vents is allowed, the vents must be permanently fixed and must meet the minimum requirements for free vent area as noted above.

VENT PLACEMENT STANDARDS

Ventilators should be placed so as to eliminate "still" air pockets in the attic. This may be accomplished by distributing the lower ventilators as widely as possible. Ventilators should be equally spread to address all attic areas in compliance with the above formulas.

All ventilators must be screened. Large "can" type roof vents (144 square inches free air) should not be utilized as low-venting where snow may be of concern.

In slate or clay tile roof applications, a combination of gable-end and soffit vents should be used when possible.

All ventilators shall be installed using manufacturer's recommendations. Holes should be cut to provide a free opening at least equal in size to the opening in the ventilator. There should be no obstructions in the line of the vent opening (be sure to cut and place ventilators so as to avoid rafters and other structural components). Low ventilators should be placed a minimum of one foot above the level insulation will be blown. Soffit vents and other low vents, which would cause blowing of loose fill insulation, should be provided with adequate baffling so as to deflect air above the surface of the attic insulation and to prevent blockage of the vents. All necessary precautions should be taken to insure a watertight installation. Roofing should overlap roof "cans" at top and sides, when possible.

INSULATION INSTALLATION ACCESSWAYS

All attic accessways, either in kneewalls or ceilings, must be installed so that they may be readily removed for post inspection purposes by subgrantee or grantee personnel. In those few cases where this practice would not be practical the subgrantee must ensure that the area insulated is inspected by an appropriate subgrantee representative prior to the permanent sealing of such accessway. This may be the case when a roof or gable end vent opening is utilized as access to an attic or ceiling area. The subgrantee must fully document in writing that the inspection process took place.

ATTIC INSPECTION FORM

MANDATORY FOR ALL ATTIC INSULATION INSTALLATIONS.

Subgrantee _____ Job # _____

Date _____

EOCD/OEC 8/81

Section A: To be filled out by auditor at inital interview with client.

Are there any recessed light fixtures in this dwelling?

Yes _____ No _____
Don't Know _____

Location _____

Section B: To be completed by Auditor upon visual inspection of ceiling area beneath attic.

1. Recessed lighting fixtures.
   Description _____
   # Room _____
   # Room _____
   # Room _____

2. Other potential producers.
   Description _____
   # Room _____
   # Room _____
   # Room _____

Section C: To be completed by Crew Chief/Contractor at time of insulation installation.

Count of recessed lights	____	should agree
Furnace Flues	____	with section B1
Other Heat Producers	____	
Chimney Areas	____	
Total Guards Needed	____	

Section D: To be signed by the insulation installer after completion.

I have installed ____ (No) insulation guards.

Signed _____

Subgrantee/Company _____

Date _____

Section E: To be signed by weatherization client.
Note: Detach section below and give to client.

I agree that the number of insulation guards indicated have been installed as noted above. I have received the notice to the client that was attached below.

_____ _____
Client Signature Date

(Detach Here)

Notice to weatherization clients: The purpose of insulation guards is to ensure that your dwelling is in compliance with the National Electric Code. The insulation used meets all Federal test specifications. However, since all insulation retains heat, it is essential that heat producing sources be protected. For this reason, it is important that insulation guards not be removed, altered or covered. Be sure to use insulation guards if you install new recessed lighting or some similar fixture. Also be sure not to obstruct any attic ventilation devices.

CERTIFICATION OF INSULATION

PART I - GENERAL

ADDRESS OF RESIDENCE:

_____

_____

DATE OF INSTALLATION COMPLETION: _____

NAME AND ADDRESS OF CONTRACTOR:

_____

_____

_____

PART II - AREAS INSULATED

WALLS (_____ sq. ft.)
TYPE OF INSULATION:

_____

MANUFACTURER:

_____

R-VALUE INSTALLED	AMOUNT INSTALLED

CEILINGS (_____ sq. ft.)
TYPE OF INSULATION:

_____

MANUFACTURER:

_____

R-VALUE INSTALLED	AMOUNT INSTALLED

FLOORS (_____ sq. ft.)
TYPE OF INSULATION:

_____

MANUFACTURER:

_____

R-VALUE INSTALLED	AMOUNT INSTALLED

PART III - CERTIFICATION

I, _____, certify that the residence identified in Part I was insulated as
(PRINT NAME)
specified in PART II and the installation was conducted in conformance to applicable codes, standards, and regulations.

_____
(Authorized Signature)

This certificate must be completed and prominently posted adjacent to all areas which are insulated with program funds.

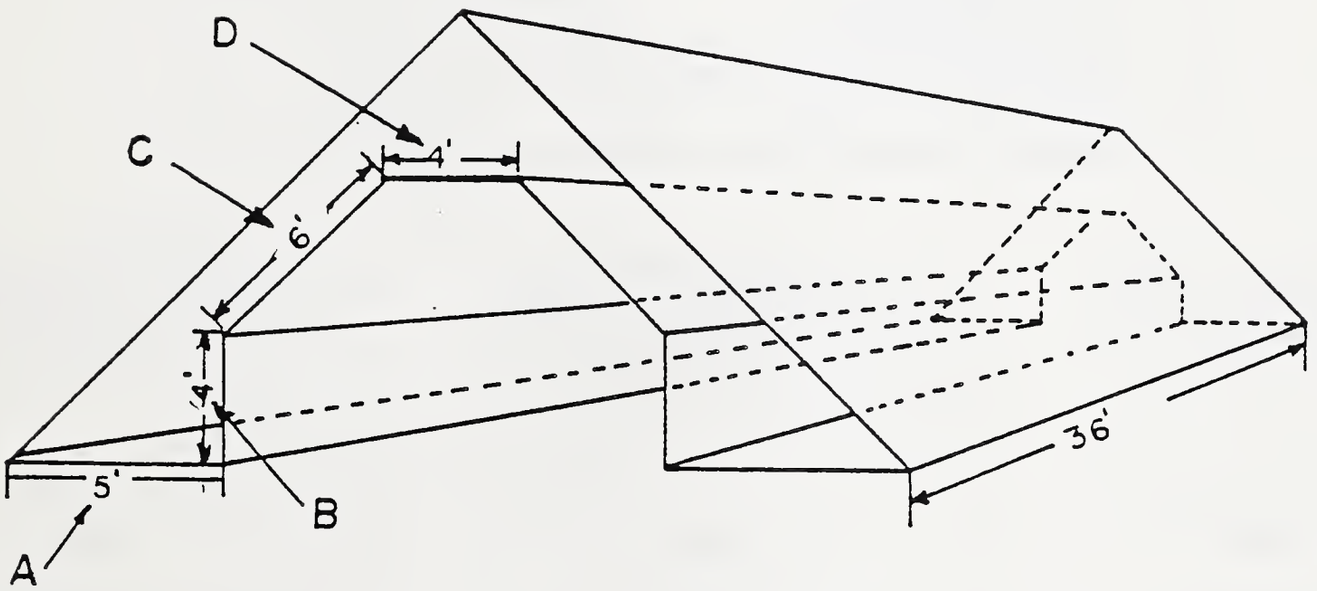
FINISHED ATTIC INSPECTION FORM

KNEEWALL FLOOR	KNEEWALL	SLOPES	FLAT CEILING
DEPTH _____ "	WIDTH _____ "	DEPTH _____ "	BLOWN DEPTH _____ "
LENGTH X WIDTH = SQ. FT.	LENGTH X WIDTH = SQ. FT.	LENGTH X WIDTH = SQ. FT.	LENGTH X WIDTH = SQ. FT.
_____ X _____ = _____	_____ X _____ = _____	_____ X _____ = _____	_____ X _____ = _____
_____ X _____ = _____	_____ X _____ = _____	_____ X _____ = _____	_____ X _____ = _____
_____ X _____ = _____	_____ X _____ = _____	_____ X _____ = _____	_____ X _____ = _____
_____ X _____ = _____	_____ X _____ = _____	_____ X _____ = _____	_____ X _____ = _____
_____ X _____ = _____	_____ X _____ = _____	_____ X _____ = _____	_____ X _____ = _____
_____ X _____ = _____	_____ X _____ = _____	_____ X _____ = _____	_____ X _____ = _____
TOTAL = _____	TOTAL = _____	TOTAL = _____	TOTAL = _____
☐ OPEN ☐ FLOORED			

VENTS	ACCESS (WALL/CEILING)	COMMENTS
TYPE SIZE NUMBER	TYPE NUMBER	
____ ____x____ _____		
____ ____x____ _____		
____ ____x____ _____		

OPTIONAL MASS. EOCD/OEC FORM

FINISHED ATTIC DIAGRAM



A - Kneewall Floor
Area = 36' x 5' = 180 sq. ft. each

B - Kneewall
Area = 36' x 4' = 144 sq. ft. each

C - Slope
Area = 36' x 6' = 216 sq. ft. each

D - Flat Ceiling
Area = 36' x 4' = 144 sq. ft.

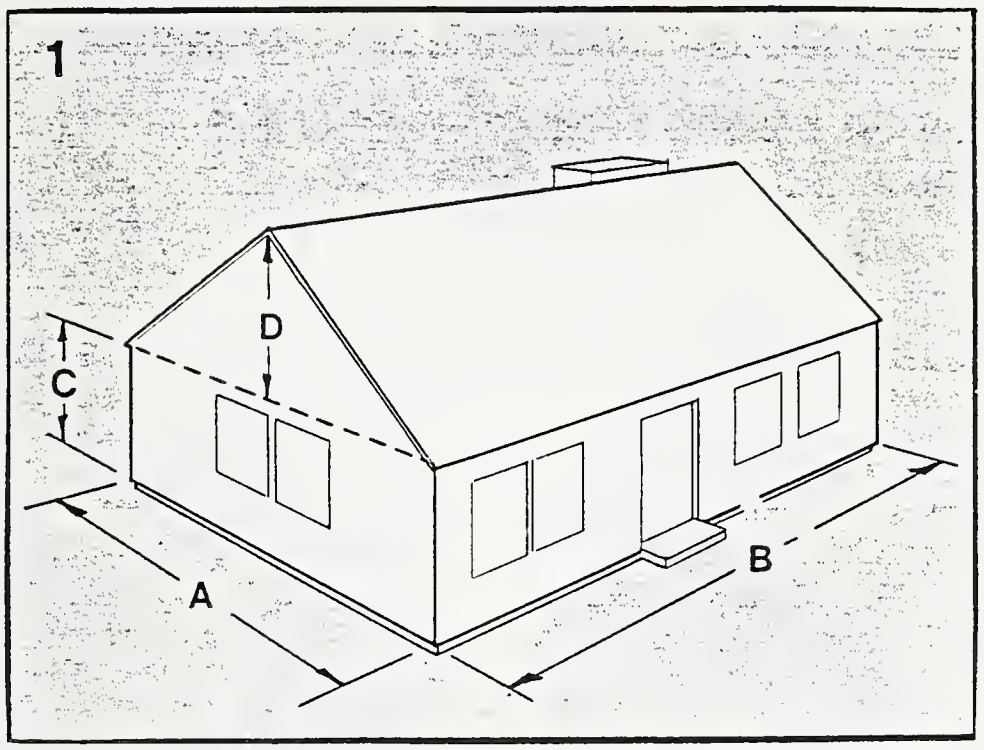
To Find Required "Free Vent Area" (FVA)

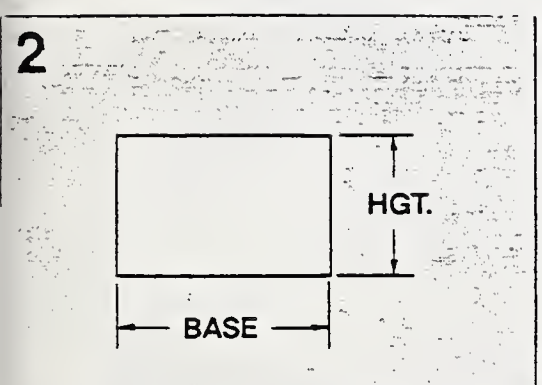
$$FVA = \frac{1}{300} \times 936 = 3.12 \text{ sq. ft}$$

3.12 sq. ft. ÷ 2 = 1.5 sq. ft. High Venting - 1.5 sq. ft. Low Venting
.75 sq. ft. in each soffit - Low Venting
.75 sq. ft. in each of 2 gable vents (one each end).

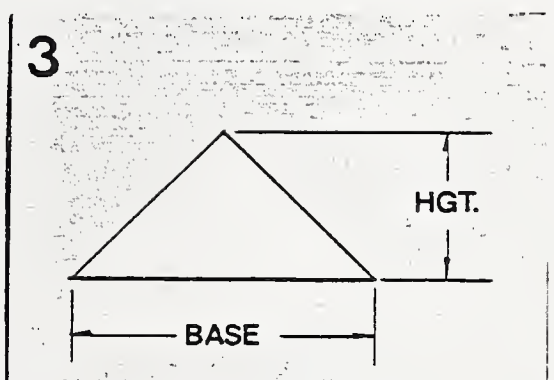
When calculating ventilation requirements for attic ceiling areas, flats and slopes are used. Vertical areas are not used in the calculation (Example Kneewall).

HOUSE AREA MEASUREMENTS

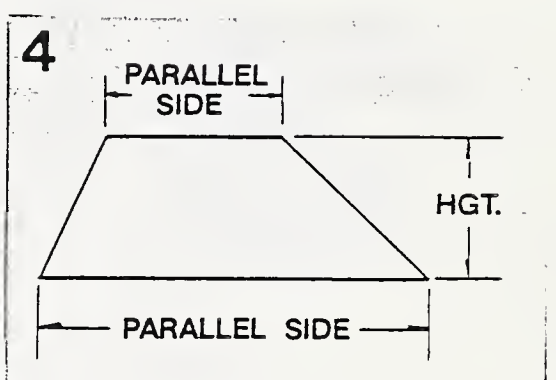




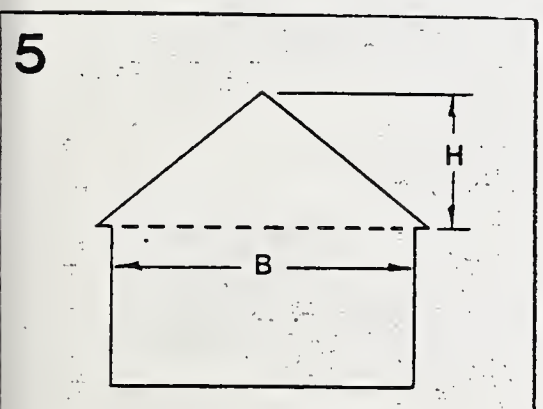
Rectangles: Base x Height = Area



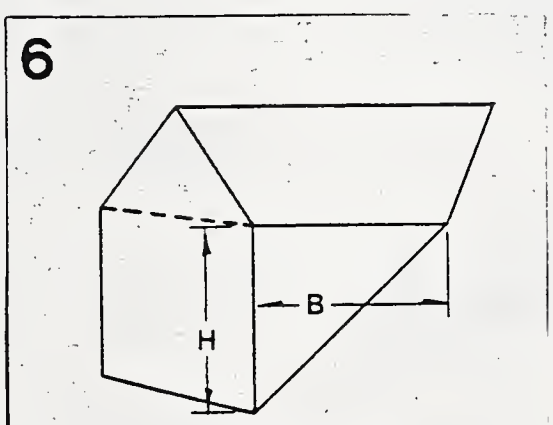
Triangle: Base x ½ Height = Area



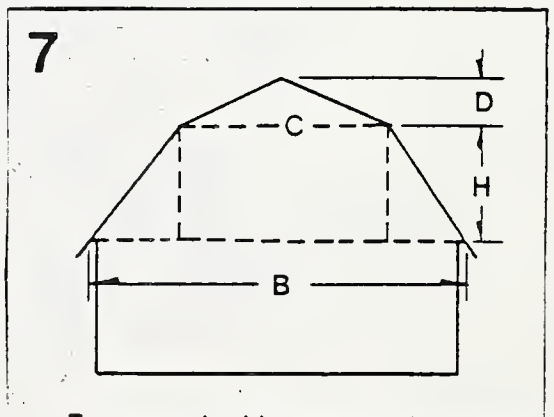
Trapezoids: Height x ½ sum of Parallel sides = Area



To find the area of the gable end, multiply B (width) by ½ H (height)



The side of a dormer is figured as a triangle B x ½ H

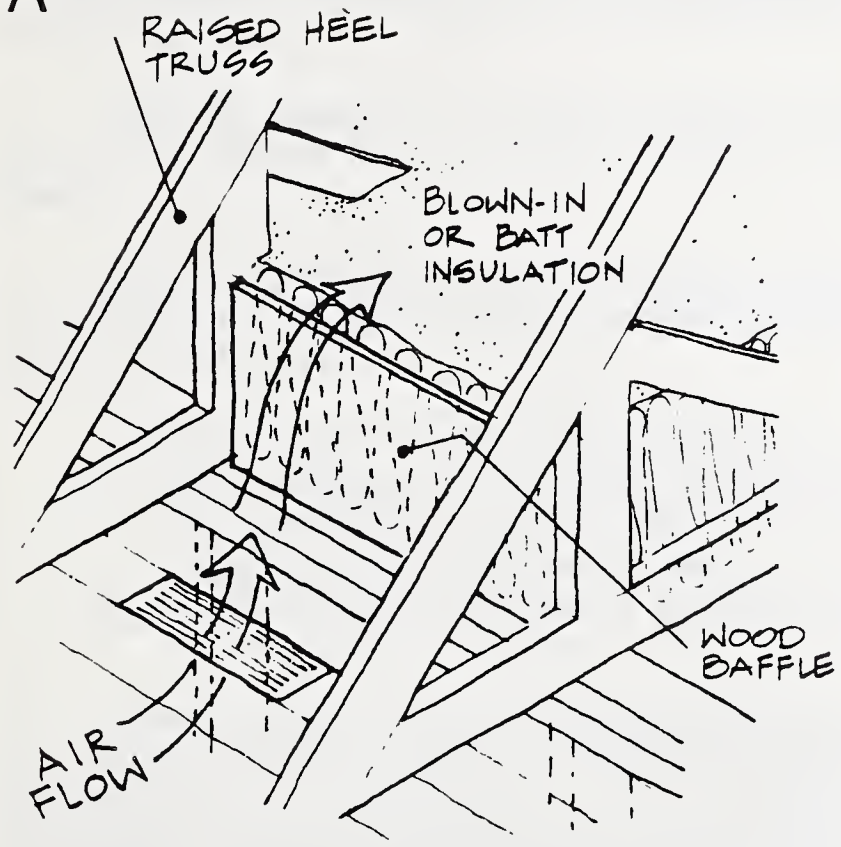


For a gambrel house, use formula ½ (B + C) x H and add for the peak (C x ½ D)

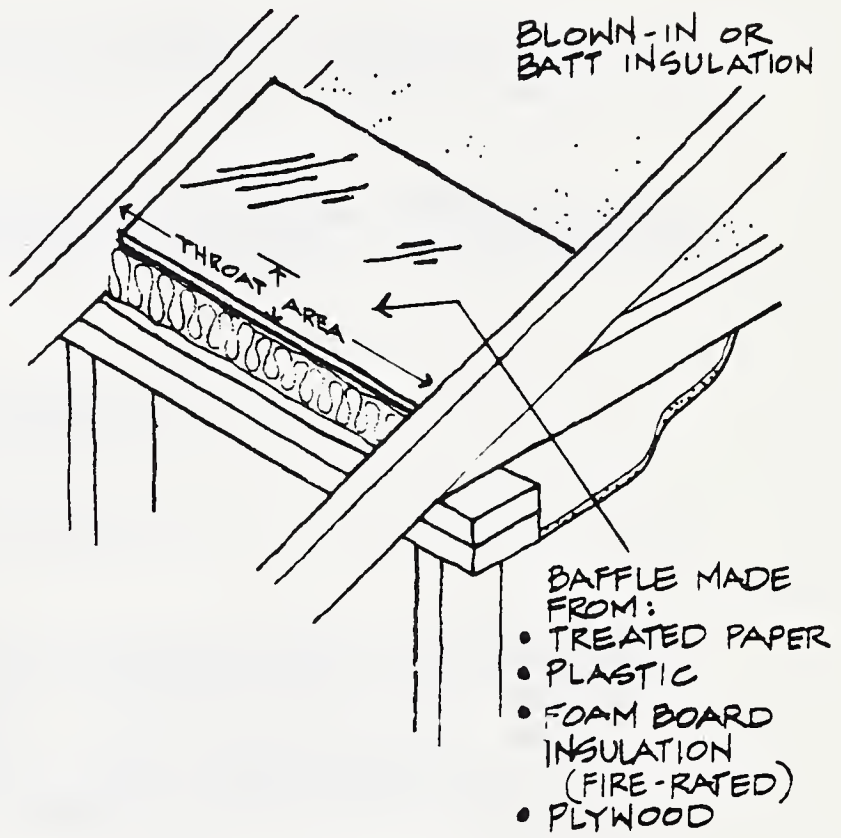
Methods for Baffling at Eaves

to Allow Air Ventilation over Insulation

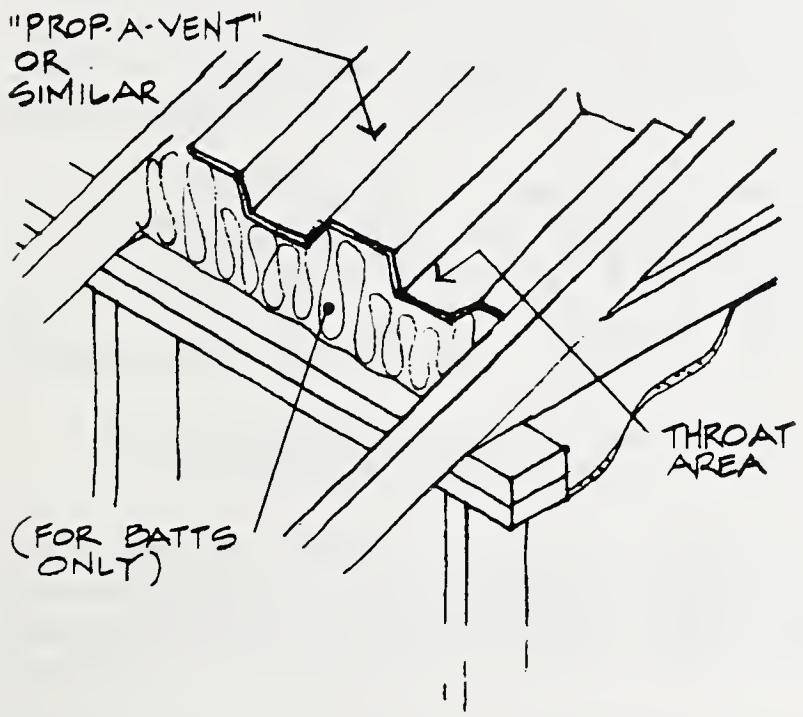
A



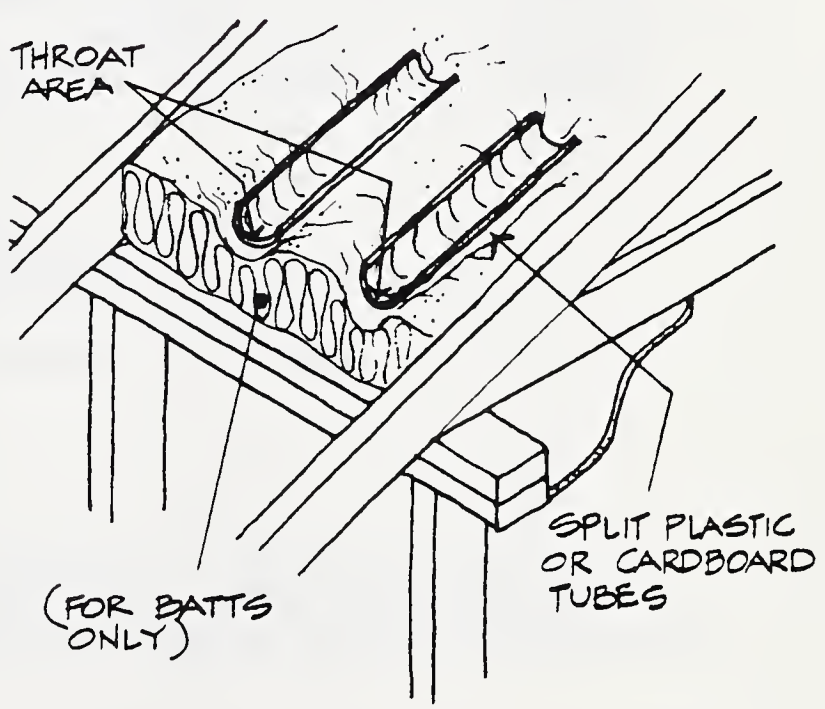
B



C



D



NOTE: FOR ALL METHODS, TOTAL THROAT AREA SHOULD AT LEAST EQUAL TOTAL SOFFIT OR EAVE VENT AREA

KNOB AND TUBE WIRING INSPECTIONS

It is mandatory for all WAP Subgrantees to have in its possession a written statement from a licensed electrician or certified electrical inspector, stating that insulation can be safely installed over knob and tube wiring, prior to authorizing the installation of any attic or sidewall insulation.

This procedure is the sole responsibility of each WAP Subgrantee and may not be delegated to a private contractor, property owner, tenant or any other party.

In defining the conditions under which insulation can be safely installed over knob and tube wiring in residential attics or sidewalls, the following must be determined:

a. the condition of the wiring;
b. the adequacy of circuit protective devices;
c. the possible need to modify the fuse box to install type "S" fuses; and
d. verification that knob and tube systems are actually in service.

Please ensure that all appropriate Subgrantee personnel and contractors are aware of the importance of this guidance. EOCD/OEC field staff will be monitoring all Subgrantee to ensure compliance with this guidance. All contracts, between EOCD and WAP Subgrantees, allow for the immediate termination of any program found to be in noncompliance with this guidance.

Knob and tube wiring is a potential hazard because it is generally found in older homes (constructed prior to 1920), and these structures were usually wired with a lower electrical service that is customary for the requirements of today's households. However, it is now felt that insulation can be safely placed over knob and tube wiring provided that:

- the wiring is in good condition; and
- the circuits do not carry an amperage greater than the rated current for that size wiring. *

Subgrantees must strictly adhere to the following fuse sizes:

- 15 amp fuses for #14 wire
- 20 amp fuses for #12 wire

The inspector should check to determine if there is evidence of cracked or frayed electrical insulation or exposed conductors. Installers of the insulation should be cautioned to use care not to damage the old wiring as the insulation is applied.

Installation of type "S" fuses are required in fuse boxes in homes where knob and tube wiring systems are used. Type "S" fuses insure against overloading by making it impossible to put in a larger rated fuse. Permission must be obtained from the client to modify the fuse box. If the resident does not consent, the insulation cannot be installed.

* National Electrical Code 1987 supports this position.

SIDEWALL INSULATION

1. DEFINITION

A material designed to resist conductive heat flow, installed within walls between either conditioned and unconditioned areas within the structure, or conditioned areas and the outside.

2. MATERIAL STANDARDS

Thermal insulation materials used to insulate sidewall cavities shall conform to those listed in the Appendix A, Standards For Weatherization Materials. NOTE: OEC strongly recommends the use of cellulose insulation when insulating sidewalls.

3. INSPECTION AND INSTALLATION GUIDELINES

Determine the amount of existing insulation.

Ask the resident if sidewall insulation has been previously installed into the structure.

Inspect the wall surfaces for evidence of drilling, plugging or removal of the siding materials.

Remove the cover plates for electrical wall outlets/switch plates and examine the cavities for evidence of insulation. Remember to interrupt the electrical current to that area before probing.

If insulation is found in a cavity, determine to what extent the insulation work has been completed throughout the structure.

A. Inspect the Structure for Evidence of Moisture Damage (i.e., peeling paint, warpage, visible stains, fungal growth, rot, or other structural damage.) If evidence of moisture damage is determined:

- o Inspect the gutter-downspout system, siding, and roofing materials, drainage around foundations, and the basement/crawlspace area for conditions indicating excessive external moisture infiltration.

- o Determine if occupant behavior, the structure's size or its construction is causing excessive amounts of internally produced moisture.

Conditions that may contribute to excessive internal moisture generation include:

- o A living area of less than 800 sq. ft.

- o Less than 250 sq. ft. of living space per occupant.

- o Tight wall and ceiling construction with thorough leakage sealing completed throughout the structure.

- o Electrically heated homes or homes with a heating system utilizing outside combustion air.

- o Homes that are humidified during the winter.

- o Clothes dryers vented into the living space.

- o Dirt floored crawlspaces with no vapor barrier.

Locate the source of severe moisture conditions and correct them prior to installing sidewall insulation.

Determine, after exploring all reasonable alternative corrective actions, if the installation of a mechanical ventilation device (fan unit) will adequately control the severe moisture condition(s). Fan units are to be charged to the Repair Material category.

B. Inspect the Interior Walls for Structural Integrity

Examine areas and conditions which might allow insulation to escape into the living space, including pocket doors, balloon construction details (i.e., openings at the top plate, sill plate, and second storey ceiling joists), unbacked cabinets and closets, ducts running through exterior walls, as well as interior and exterior wall surface integrity, such as visible cracks, holes, unbacked paneling, etc.

Determine whether those conditions will allow insulation to escape and whether they can be adequately corrected. If the conditions cannot be corrected, determine if the specific area can be left uninsulated without drastically reducing the thermal performance of the entire retrofit.

C. Inspect the Electrical Service

Determine whether the wiring runs through the exterior wall cavities and note the conditions of that wiring where it is visible.

Note the wire guage and ensure that circuit protectors are matched to the appropriate wire size. The following protection is required:

- o 15 AMP for #14 Wire
- o 20 AMP for #12 Wire

If operable knob and tube wiring is present it is mandatory for all WAP subgrantees to have in its possession a written statement from a licensed electrician or certified electrical inspector, stating that insulation can be safely installed in sidewall cavities which contain knob and tube wiring, prior to authorizing the installation of any sidewall insulation.

This procedure is the sole responsibility of each WAP subgrantee and may not be delegated to a private contractor, property owner, tenant or any other party.

If the condition of the wiring cannot be corrected and, in the case of knob and tube wiring, the homeowner will not allow the installation of properly sized S-type fuses, determine if the specific cavities containing wiring can be left uninsulated without drastically reducing the thermal performance of the entire retrofit. Do not complete the retrofit if the conditions cannot be corrected (including owner permission for S-type fuses) or if specific cavities cannot be left uninsulated without drastically reducing cost-effectiveness.

D. Inspect the Routing of the Mechanical Services

Locate and note the pathways that plumbing, wiring, heat runs, air return runs and gas lines take through the exterior walls. Take steps to assure that the installation of insulation will not damage or in any way hinder the normal function of those services. In some cases, cavities or groups of cavities may have to be left uninsulated. Determine if the specific area can be left uninsulated without drastically reducing the thermal performance of the entire retrofit.

E. Inspect the Exterior Siding

Determine if the siding is of a type that can be loosened or removed in a safe and efficient manner. Sidings must be unlocked/removed unless the homeowner gives the prior written permission to drill and plug them.

Inspect for missing or damaged siding and other conditions which would allow insulation to escape from and/or precipitation to enter into exterior wall cavities.

4. INSTALLATION PROCEDURES

A. Pre-Installation Procedures

Ensure that the moisture conditions detected in the structure during the course of the initial inspection are corrected prior to insulation of the sidewall cavities. This may be accomplished by one or more of the following techniques:

- Provide a vapor barrier on the interior surface of the walls in bathrooms, kitchens, laundry rooms, and any other high moisture areas.

- Thoroughly seal all cracks and holes through the interior wall surfaces in high moisture areas.

- Install a vapor barrier and ventilation into high moisture crawlspaces.

- Correct exterior structural flaws that admit precipitation into the wall cavities, i.e., repair gutter, downspout, drainage system, and seal gaps above door/window casings.

- Install an adequate moisture control system in the attic.

- o Vent clothes dryers to the outside.

- o Advise the owner/occupants to lower their humidifier and/or to change lifestyle practices which contribute significantly to high humidity.

- o Install an independently controlled mechanical ventilation device in high moisture living areas.

Ensure that all openings in sidewalls through which the insulation can escape are blocked as follows:

- o Missing interior wall surfaces will be covered with a compatible material (i.e., drywall) and sealed into place.

- o Missing or damaged exterior siding on homes with incomplete or no subsiding will be replaced/repaired.

- o Wall cavities with no top plate and/or open at the sill plate will be blocked and sealed with an air impermeable barrier.

Carefully locate and avoid accessing and insulating wall cavities that would either allow insulation to escape or present a hazard to the occupant, installer or the home's structural/mechanical integrity, i.e., heat ducts, recessed lights, vent fans, electrical service entrances, etc.

B. Installation Procedures

Two (2) basic techniques are acceptable for accessing and insulating sidewall cavities. In any given structure, either or both of the following techniques may be required to assure complete insulation of all wall cavities.

One method involves drilling a minimum of two (2) holes per one storey cavity and installing insulation through those holes.

- o Access wall cavities with a minimum of two (2) holes per storey with no more than 5' distance between those holes. Entry holes will then be probed to locate fire stops or other obstructions which may necessitate additional entry holes to assure the maximum pressurization practical for that cavity. This process applies to exterior siding, subsiding, and interior wall surface applications.

The second method involves drilling one (1) hole at the top or bottom of each one storey cavity, inserting a flexible tube through the hole until it reaches the opposite end of that cavity, and installing insulation by withdrawing the tube as the cavity fills.

IMPORTANT: This method may only be used when the two (2) hole method is inappropriate due to siding type or condition.

- Access the wall cavities with a single hole drilled at either the top or bottom of each wall cavity (i.e., top or sole plate, behind the baseboard or crown molding, etc.). Entry holes will then be probed to locate fire stops or other obstructions that may necessitate additional entry holes. Additional entry holes can be drilled through either the opposite cavity end, or accessed through the interior or exterior wall surfaces. A flexible tube long enough to reach to the opposite end of the cavity, can then be inserted into the cavity and withdrawn as the cavity fills and pressurizes.

  It is imperative that a tube be used with this technique. A single hole technique will not pressurize a cavity unless a tube is used to install the insulation.

Follow manufacturer recommendations on air pressure settings unless it has been determined by testing that a machine's capability to pressurize a cavity has been altered by mechanical, material, or atmospheric conditions.

Close all entry holes in a professional manner using techniques and materials that ensure a complete, secure seal. If the siding is removed, the subsiding need not be plugged prior to siding replacement.

C. Post-Installation Procedures

Thoroughly clean the work area and remove any debris or materials left over from the access and installation process.

Prime any wood used in closing the access holes or in other preparatory repairs that is left exposed to the weather.

Assure that the cavity access coverings are securely sealed and fastened into place.

After completing installation of thermal insulation materials, the person responsible for installation must complete a "Certificate of Insulation" form. The "Certificate of Insulation" must be posted adjacent to the building's electrical service panel.

5. RESTRICTIONS

If a contractor determines that the sidewalls of a building have previously been insulated during an installation, and no further retrofit is possible, then the reimbursement for that measure is limited to $25 for labor expended.

A contractor always retains the right to perform an inspection of a building's sidewalls prior to accepting a job.

6. COVERAGE

Voids of any type or size, other than those previously mentioned, are unacceptable when insulating sidewall cavities. OEC requires insulators to return and reinsulate any sidewall areas which lack adequate insulation material.

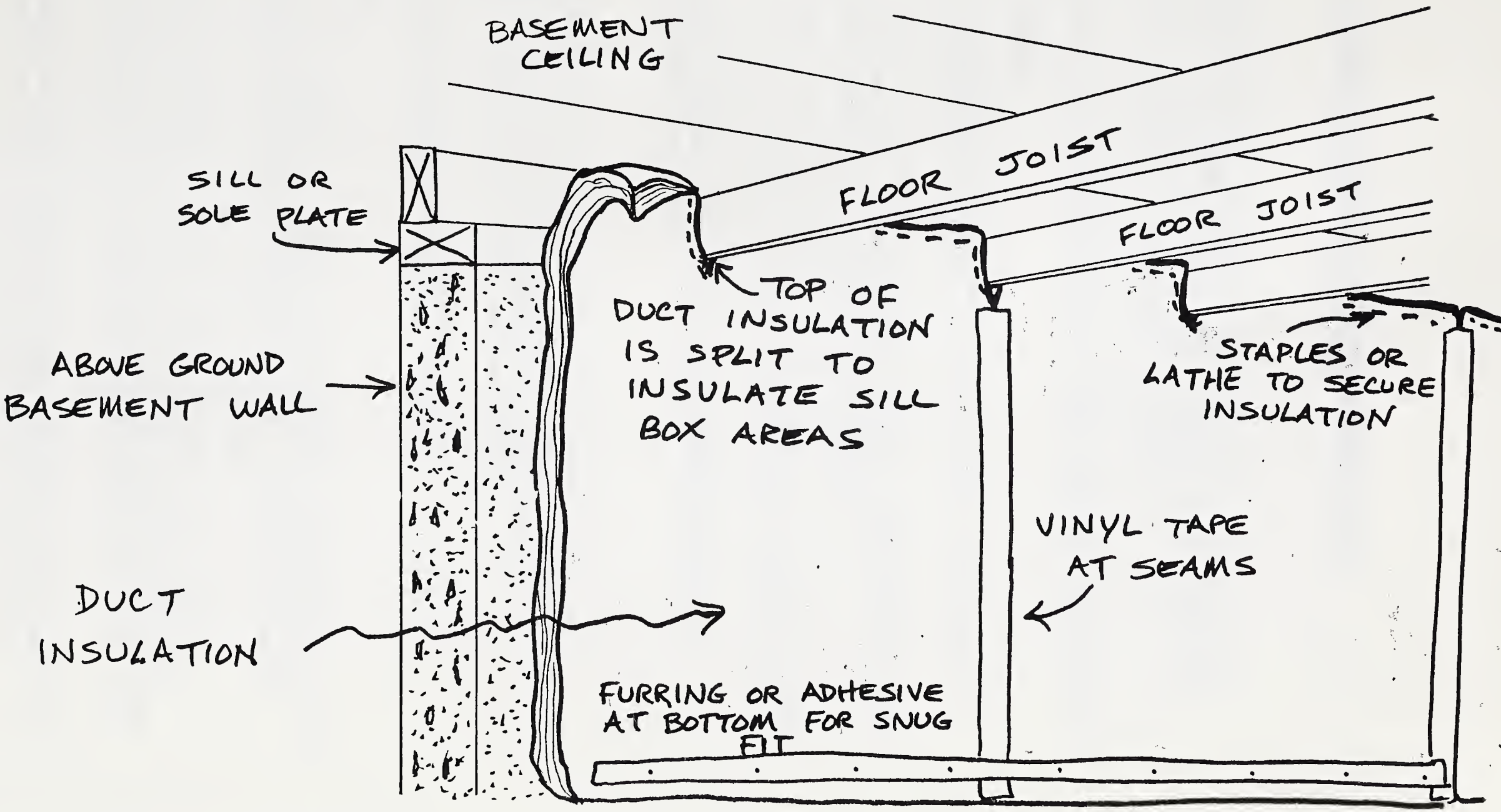
PERIMETER INSULATION

1. **Definition:** A material or assembly of materials used primarily to provide resistance to heat flow by conduction through foundation walls.

2. **Important:** The Office of Energy Conservation does not recommend perimeter insulation in all cases. When the nature of the housing and residents suggests the insulation would remain in place only on a temporary basis at best, then this measure should not be attempted. Also, where moisture is a factor and cannot be effectively controlled, perimeter insulation is not recommended. However, this does not preclude the installation of sill insulation.

3. **Procedure:** Insulate the interior of basement foundation walls with $1\frac{1}{2}$" - 2" vinyl or reinforced foil-faced duct wrap. The insulation must extend from the top of the sill box to a point at or below the exterior grade. All seams must be taped and furring strips or construction grade adhesives must be used to secure the bottom section of the insulation to the wall.

INSTALLATION OF PERIMETER INSULATION


BASEMENT CEILING
FLOOR JOIST
FLOOR JOIST
SILL OR SOLE PLATE
TOP OF DUCT INSULATION IS SPLIT TO INSULATE SILL BOX AREAS
STAPLES OR LATHE TO SECURE INSULATION
ABOVE GROUND BASEMENT WALL
VINYL TAPE AT SEAMS
DUCT INSULATION
FURRING OR ADHESIVE AT BOTTOM FOR SNUG FIT

STORM WINDOWS/REPLACEMENT WINDOWS/REPLACEMENT DOORS

DEFINITIONS:

Storm Windows: A unit consisting of glazing material installed in a window opening either outside or inside a prime window, creating an insulating air space to provide greater resistance to heat flow than the prime window alone. The storm window may be removable or permanently attached.

Replacement Windows: A single or double-glazed window unit which would replace the original prime window and would provide for a more airtight construction.

Movable Insulation Systems:

a. Window Shutter - A rigid insulating plate used to cover a window for the purpose of reducing heat-loss.

b. Window Shade - A device that consists mainly of one or more flexible sheets or quilts and can be unrolled (or vertically raised or lowered) to cover a window and, when not needed, can be moved out of the way.

c. Window Quilt - Several flexible sheets of cloth or plastic (or plastic foam) attached to one another in series to form a thick, soft, flexible assembly.

Replacement Doors: A standard or insulated hinged or sliding patio unit which is installed in an exterior door opening and is weatherstripped to provide greater resistance to heat flow.

PROCEDURES:

Exterior Storm Windows are to be installed on single-glazed window units which separate conditioned and unconditioned spaces. Exterior Storm Windows must be installed consistent with the recommended priority listing. No reasonably repairable existing storm window may be replaced.

NOTE: WAP Subgrantees may choose to utilize either exterior or interior storm windows when installing additional glazing.

Interior Storm Windows

1. When a dwelling unit consists of single glazed windows, storm windows of the interior type may be ranked equal to the #1 priority General Heat Waste. This option does not preclude the weatherstripping, caulking, or general tightening of a very loose or drafty prime window unit.

2. When a dwelling unit consists of double glazed windows, (i.e. exterior storm window and prime window) the interior type storm window should be considered as an optional weatherization measure and placed after all other applicable measures listed in the Recommended Weatherization Priority List for the appropriate building type.

An exception to procedure (2) may be made only when a dwelling unit consists of prime windows that cannot be weatherized using the accepted infiltration

techniques such as weatherstripping and caulking or when existing exterior storm windows are in such a state of disrepair that they serve no useful function.

Movable Insulation Systems are not to be utilized to replace exterior and interior storm windows as an insulation material, nor is it an allowable expense to install movable insulation systems and storm windows on the same window. However, when storm windows are an applicable priority measure, but they cannot be installed for some reason, such as construction barriers, as in the case of many mobile homes or basement windows, Movable Insulation Systems should be utilized. Movable Insulation Systems although effective in selective instances, are relatively expensive and must be properly "managed" by the residents to be effective.

Replacement Windows are to be utilized as an allowable weatherization material only after all other reasonable repair options have been considered and rejected. Single-glazed, double-hung replacement sash, either individual, or pre-hung units, are to be considered replacement windows.

Replacement Doors, either hinged or sliding patio units, are to be utilized only after all other reasonable repair options have been considered and rejected. Replacement Doors are to be considered as an allowable weatherization material cost.

FLOOR INSULATION

1. **Definition:** A material primarily designed to resist heat flow and installed between the first level conditioned area of a building and an unconditioned basement or crawl space.

2. **Requirements:**

   1. Floor insulation must be a minimum of R-19.

   2. The insulation must always be installed with the vapor barrier facing the winter warm side.

   3. Do not compress insulation.

      A. Where insulation is to be installed beneath floors over crawl space.

         1. Cover all dirt surfaces with a ground cover which acts as a vapor barrier (6 mil polyethylene sheeting).

         2. Provide one square foot of ventilation for every 1500 square feet of ground area with a vapor barrier, or one square foot of ventilation for every 150 square feet of ground area without a vapor barrier.

DUCT AND PIPE INSULATION

Definitions:

Duct Insulation is a material primarily designed to resist heat flow which is installed on a heating supply duct.

Pipe Insulation is a material primarily designed to resist heat flow which is installed on a heating pipe.

Procedures:

Duct Insulation:

1. Tape all loose joints on heating ducts.

2. Wrap 1½" - 2" vinyl-backed or reinforced foil duct wrap as completely as possible around the duct.

3. Carefully butt or overlap the ends of the insulation together and staple the joints.

Domestic Hot Water Pipe Insulation:

1. Ensure before insulating that the hot water pipes do not leak.

2. Insulate only the first six (6) feet of hot water pipe from the water heating source, unless the floor above is insulated, in which case it may be necessary to insulate all domestic water pipes. The energy auditor should make this determination.

Hydronic Space Heating Pipe Insulation:

1. Ensure before insulating that the heating pipes do not leak.

2. Insulate only the supply side hot water or steam pipes (Be sure the insulation is rated to withstand the heating pipe temperature).

3. Do not insulate pumps, valves, boiler feed lines, pressure relief devices, or vents.

Priorities:

Duct Insulation is to be considered a mandatory weatherization measure.

Domestic Hot Water Pipe Insulation must be installed on the first six (6) feet of hot water pipe and must be included in the General Heat Waste category as a number 1 priority. In some instances, such as freezing pipes, all the hot water pipes may be insulated.

Hydronic Space Heating Pipe Insulation is to be considered a mandatory weatherization measure.

INCIDENTAL REPAIRS/MAJOR REPAIRS

INCIDENTAL REPAIRS

"Incidental repairs" is defined by regulation as "repairs to an eligible dwelling unit which are necessary for the effective performance or preservation of an allowable energy conservation measure." An "incidental repair" may only be performed in conjunction with an allowable energy conservation measure. Thus, reshingling a leaking roof or upgrading the electrical wiring in an attic may only be performed when a subgrantee is going to insulate the attic.

The following is a list of some of the most common repair materials utilized by WAP subgrantees:

- Lumber
- Parting beads
- Roof and sidewall shingles
- Flashing
- Vinyl, aluminum, and clapboard siding
- Masonry supplies

"Incidental repairs" are limited to a maximum expenditure of $500 per eligible dwelling unit, inclusive of labor and materials. Subgrantees may access this money without prior OEC approval from within their allocated budgets. The cost of "incidental repairs" is in addition to the maximum cost per eligible dwelling unit of $2,000 for allowable energy conservation material and labor (Refer to Appendix A of the Technical Manual).

All "incidental repair" expenditures must be itemized as to repair material and repair labor.

When a subgrantee reports the cost of "incidental repairs" on the Building Weatherization Report (BWR) it must be reported in the following manner:

- The cost of "incidental repair" material must be entered on Line #8 of Section 5, "Costs; Repair Material."

- The cost of "incidental repair" labor which was performed by a contractor must be entered on Line #9 of Section 5, "Costs; Contractor Repair Labor."

- The number of hours attributable to "incidental repair" labor which was performed by a subgrantees direct hire crew is not reportable on the BWR.

MAJOR REPAIRS

A maximum of $500/per eligible unit, over and above the $500 "incidental repairs," may be accessed for "major repairs," such as roof and electrical work that is necessary to install needed allowable weatherization measures. This additional $500 may be combined with the $500 "incidental repair" limit for a total of $1,000. However, OEC prior approval for each request to access the "major repair" fund is necessary.

After prior verbal approval is received from OEC, the subgrantee must send to OEC, attention of Ken Rauseo, a written request for approval which will include the bids received for the work to be done.

Major Repair fund expenditures are reimburseable by submitting a separate invoice to OEC requesting payment upon the completion and acceptable post-inspection of the repair work. Major Repair fund expenditures are not to be reported on the BWR or included in a subgrantee's monthly report. A subgrantee will report the first $500 for incidental repairs on the BWR in any combination of materials only, labor and materials, or labor only (most unlikely) it chooses so long as 1) the method used for reporting is consistent with the guidance contained in the first part of this memorandum and 2) the sum of the incidental repairs (as stated on the BWR) and the sum of the invoice requesting payment for the major repairs equals and does not exceed the total sum as requested by the subgrantee in the written letter seeking approval.

Unlike incidental repairs, which are charged to a subgrantee's budget, major repair funds are accessed from a separate reserve pool of funds held by the Grantee. Consequently, major repair fund expenditures are in addition to a subgrantee's budget.

QUALITY CONTROL

A comprehensive, detailed and fully documented Quality Control procedure is an important part of any Weatherization Assistance Program. The regular use of a well designed Quality Control procedure tells the WAP Coordinator a great deal about the effectiveness of their operations. Moreover, it identifies potential problems in the program while still in the correctable stage.

Each Subgrantee must have a Quality Control procedure it routinely uses to assess the quality and completeness of weatherization work performed by a contractor or crew. This procedure must be fully documented in writing.

Whenever a Subgrantee weatherizes a dwelling unit someone from that agency with construction and energy conservation experience must inspect and approve as complete all work invoiced by a contractor prior to issuing payment to that contractor and submitting the job to EOCD/OEC. If there are any problems or discrepancies with the work, the subgrantee must document the resolution of the problem prior to payment. In agencies with crews, a staff member not associated with that crew must inspect the work and certify that the work done was acceptable and all materials listed were installed as specified prior to submitting the job to EOCD/OEC as a completion. In this way the Subgrantee can be sure every home reported as completed is done to the specifications as mandated by EOCD/OEC and the work meets normal quality standards.

Each Subgrantee must develop clear documentation of proper Quality Control procedures. When using contractors, the Subgrantee must develop a procedure that includes a standardized Quality Control form used in conjunction with the contractors itemized invoice. The Quality Control inspector must check off each item as complete and acceptable prior to contractor payment. All insulation jobs must be remeasured to ensure accuracy of square footages. All Quality Control forms must be signed and dated by the inspector. If a contractor must seal off an insulation accessway or uses roof or gable end vents as access to an attic area no matter how small, the Subgrantee must perform an inspection of that work prior to the area being sealed off. The inspector must certify that the insulation is complete and installed to the required R value. This visit must be completely documented in writing.

EOCD/OEC strongly recommends that Subgrantees require contractors to notify the WAP office on the day they are doing wall insulation jobs for the agency. The Subgrantee should then make regular unannounced in-process inspections to determine that accessing and blowing techniques are consistent with program regulations. This inspection must be fully documented by a Quality Control inspector and does not preclude the need for a final inspection of the job after the contractor completes the work.

EOCD/OEC strongly encourages Subgrantees to make regular in-process inspections of all WAP work done by contractors and crews.

POST INSPECTION
QUALITY CONTROL WORKSHEET

CLIENT _____
ADDRESS _____
_____
PHONE # ( ) _____
CONTRACTORS
GENERAL HEAT WASTE _____
INSULATION _____

JOB # _____
OATE WORK COMPLETEO _____
OATE OF QUALITY CONTROL _____
SIGNATURE OF INSPECTOR

STORM WINDOWS _____
OIL BURNER _____

WEATHERIZATION MEASURE	WORK REQUIREO PER JOB ORDER	WORK INVOICEO	QUALITY OF WORK				COMMENTS
			GOOO	FAIR	POOR	NONE	
LIVING AREA INSPECTION							
WEATHERSTRIPPING							
A. WINOOWS							
B. OOORS							
THRESHOLOS							
WINOOW REPAIRS							
A. PARTING BEAOS							
B. GLASS REPLACEMENT/PATCH							
C. GLAZING							
O. SASH ROPES							
E. WINOOW LOCKS							
F. SASH SPRINGS							
G. WINOOW CHANNELS							
WINOOW REPLACEMENT							
STORM WINDOW REPAIR							
CAULKING							
ELECTRICAL OUTLET INSULATORS							
OOOR REPAIR							
LOW FLOW SHOWERHEAOS							
FAUCET AERATORS							
EXTERIOR STORM WINDOWS							
INTERIOR STORM WINDOWS							
SIDEWALL INSULATION							
OTHER							
ATTIC INSPECTION							
KNOB & TUBE WIRING							
OPEN BLOW							
FLOORED ATTIC							
KNEE WALL							
KNEE WALL FLOORS							
SLOPES							
RAFTERS							
ROOF REPAIRS							
VAPOR BARRIER							
ACCESS OOOR							
DAMMING & BLOCKING							
PULL DOWN STAIRCASE							
WALK UP STAIRCASE							
ROOF VENT							
RIDGE VENT							
GABLE VENT							
SOFFIT VENT							
CERTIFICATION OF INSULATION							
OTHER							
BASEMENT INSPECTION							
SKIRTING							
FLOOR INSULATION							
PERIMETER INSULATION							
SILL BOX INSULATION							
BASEMENT DOOR INSULATION							
BULKHEAO WEATHERIZATION							
WATER HEATER INSULATION							
OUCT WRAP							
PIPE WRAP							
BASEMENT WINDOWS							
FOUNOATION PATCHING							
CRAWL SPACE/GROUND COVER							
OTHER							
HEATING SYSTEM INSPECTION							
CLEAN OUT & TUNE UP							
BURNER REPLACEMENT							
CLOCK THERMOSTAT							
REPAIRS							
OTHER							

GUIDELINES FOR THE WEATHERIZATION OF MULTI-FAMILY RENTAL BUILDINGS

BUILDING WITH LESS THAN 50% OF THE DWELLING UNITS ELIGIBLE

When less than 50% of the dwelling units in a building are eligible for weatherization the following procedure is mandatory:

1. All applicable General Heat Waste, Heating System and Storm Window measures must be performed to the eligible dwelling units.

2. All common areas (hallways, attics, basements) which are adjacent to an eligible dwelling unit must be weatherized.

3. The building's ineligible dwelling units cannot be weatherized.

4. Allowable expenditures (material and labor) are limited to those of the eligible dwelling unit or units and production credit will be granted to the eligible dwelling unit or units only.

BUILDING WITH FIVE (5) OR MORE UNITS AND 50-65% OF THE UNITS ARE ELIGIBLE

When buildings with five (5) or more units and 50-65% of the units are eligible for weatherization the following procedure is mandatory:

1. All applicable General Heat Waste, Heating System and Storm Window measures must be performed to the eligible dwelling units.

2. All common areas (hallways, attics, basements) regardless of their location in relation to the eligible dwelling units, must be weatherized.

3. The building's ineligible dwelling units cannot be weatherized.

4. Allowable expenditures (material and labor) are limited to those of the eligible dwelling units and production credit will be granted to the eligible dwelling units only.

50% OF THE DWELLING UNITS IN TWO (2) OR FOUR (4) UNIT BUILDING OR AT LEAST 66% OF THE DWELLING UNITS IN ANY BUILDING ARE ELIGIBLE

When 50% of the dwelling units in a two (2) or four (4) unit building or at least 66% of the dwelling units in any building are eligible for weatherization a subgrantee may elect either of the following procedures:

1. The subgrantee may elect to weatherize the entire building including all eligible dwelling units, common areas and ineligible dwelling units. If a subgrantee elects this option the following procedure is mandatory:

   a. The building must be weatherized in its entirety.

b. The building must be weatherized consistent with the applicable Massachusetts Priority listing MA-1 or MA-2 with the entire building's General Heat Waste and Heating System categories addressed prior to advancing to other measures.

c. Allowable expenditures (material and labor) are limited to those of the eligible dwelling unit or units plus an additional material expenditure limit (material waiver) of $200, but not to exceed $950, on an eligible dwelling unit when an ineligible unit is weatherized. Example: a 4-family building with 2 units eligible and 2 units ineligible and the 2 ineligible units are receiving assistance, the maximum amount of material funds which may be spent on the entire building would be $950 x 2 = $1,900.

d. Production credit will be granted for each ineligible unit weatherized.

2. The subgrantee may elect to weatherize only the eligible dwelling unit or units and all the common areas. If a subgrantee elects this option the following procedure is mandatory:

a. All applicable General Heat Waste, Heating System and Storm Window measures must be performed to the eligible dwelling units.

b. All common areas (hallways, attics, basements), regardless of their location in relation to the eligible dwelling units, must be weatherized.

c. Allowable expenditures (material and labor) are limited to those of the eligible dwelling units and production credit will be granted to the eligible dwelling unit or units only.

WEATHERIZING AND REPORTING INCOME INELIGIBLE DWELLING UNITS

Proper implementation of the following policy will ensure that subgrantees receive proper production credit and are accurately reimbursed for all material and labor expenditures which are incurred when weatherization is performed upon income ineligible dwelling units in multi-family rental buildings.

1. A Building Weatherization Report (BWR) must be submitted, along with the Weatherization Monthly Report, for each individual dwelling unit which receives assistance. This requirement is applicable for both income eligible and ineligible dwelling units.

2. All BWRs which are submitted to EOCD/OEC for production credit and for reimbursement of allowable material and labor expenditures for both eligible and ineligible dwelling units must be completed accurately, thoroughly, and signed by an authorized individual.

3. All BWRs which are submitted for income ineligible units must be clearly identified as such by checking the "income ineligible unit" box (A.3.) under client information.

4. All conservation improvements, material and labor costs, repairs, and in-kind contributions which are directly attributable to a dwelling unit, either eligible or ineligible, must be reported on that unit's BWR.

Measures such as weatherstripping of windows and doors, installation of storm windows, installation of water heater wrap, and maintenance of heating equipment which are performed on a dwelling unit, not to a common area, must be charged directly to that unit's BWR and against that unit's maximum material and labor expenditures. An individual dwelling unit's maximum allowable expenditure limits are:

Materials	$750 or $950 with an allowable material waiver
Total Cost/Unit	A subgrantee can spend as must as, but no more than $2,000 on any one unit for energy conservation measures, retaining at all times the $750 or $950 energy conservation materials limit.

NOTE: There is no difference in the allowable maximums between eligible and ineligible units where the 50% and the 66% rules apply!

In other words, the $200 materials waiver is not all that can be spent on the ineligible unit. A subgrantee may spend as much as $750 or $950 on an ineligible unit, so long as the subgrantee does not spend more than is allowable on all the units in the building as determined by these "Guidelines For The Weatherization of Multi-Family Rental Buildings.

5. Weatherization costs and improvements which are performed to common areas of buildings (such as attics, basements, hallways) consistent with the Multi-

Family Rental Building Guidelines, are to be divided among the BWRs for that particular building. Common areas are to be divided in any manner among the BWRs which will ensure that the building receives maximum weatherization assistance.

NOTE: Ensure that the regulatory expenditure maximums for material and labor are not exceeded on any individual BWR.

Maximum expenditure limits for Multi-Family Rental Buildings are:

Materials	$750 times (x) the number of income eligible dwelling units in a building, plus all applicable $200 material waivers, not to exceed one allowable material waiver per eligible dwelling unit.
Total Cost/Building	$2,000 times (x) the number of income eligible dwelling units, inclusive of the above $950 materials maximum.
Repairs	$500 times (x) the number of income eligible dwelling units.

Subgrantees should also be mindful of the fact that income ineligible dwelling units may only receive weatherization assistance in multi-family rental buildings where a minimum of one dwelling unit is occupied by a tenant. Privately owned condominiums and cooperatively owned buildings may not receive assistance under the Multi-Family Rental Building Weatherization Guidance unless they are inhabited by income eligible tenants on an individual dwelling unit basis.

REWEATHERIZATION

1. Reweatherized units, effective April 1, 1987, will come from three (3) funding sources.

   a. Units originally weatherized before September 30, 1979, are eligible for reweatherization with DOE WAP or DOEXXON WAP funds.

   b. Units originally weatherized after September 30, 1979, and before December 31, 1981, are eligible for reweatherization with EXXONWAP funds.

   c. Units weatherized under any OEC administered funding source through December 31, 1981, and are now MWAP eligible may be reweatherized with MWAP funds.

2. Units considered for reweatherization must be treated as first time applicants. That means an application must be taken, income must be documented, eligibility must be determined, an inspection must be performed, and after the work is completed a QC must be performed. The application must be clearly marked "Reweatherization" across the top of the application.

3. Work to be performed on the unit must comply with the OEC priority list at the time of inspection and reweatherization. The amount to be spent on the unit for reweatherization work will comply with the maximum amount allowed for weatherization of any unit at the time the unit is certified for reweatherization.

4. Units may not be reweatherized if the applicant is not income eligible at the time of application for reweatherization.

5. An agency will not be reimbursed for any reweatherized unit until the agency's priority system for serving clients on a waiting list has been approved by OEC. The priority system should be submitted to the OEC Assistant Energy Planner.

PROCUREMENT REQUIREMENTS

A. PROCUREMENT GOALS AND OBJECTIVES

1. The Subgrantee must ensure that all procurement of weatherization materials and services is conducted in a manner to provide open and free competition and to avoid any appearance of impropriety.

2. The Subgrantee must maintain a written code of conduct to govern the performance of its officers, employees, or agents engaged in the award of subcontracts and the administration of weatherization funds. The code shall include at a minimum the following provisions:

   a. No Subgrantee employee, officer, or agent shall participate in the selection, award, or administration of a subcontract in which weatherization funds are to be used where to his or her knowledge any of the following persons or entities may possibly benefit from the selection, award, or administration of such subcontract:

      (i) The employee, officer or agent;
      (ii) A member of the immediate family of the employee, officer, or agent;
      (iii) A partner of the employee, officer, or agent;
      (iv) An organization in which any person described in subsections (i) through (iii) above has a financial interest or with whom said person is negotiating or has any arrangement concerning prospective employment.

   b. No Subgrantee employee, officer, or agent shall solicit or accept gratuities, favors, or anything of monetary value from a contractor or vendor or potential contractor or vendor;

   c. Disciplinary actions to be applied for violations of the code.

3. The Subgrantee shall make positive efforts to utilize small and minority owned businesses as a source of supplies and services. Such efforts shall allow these sources the maximum feasible opportunity to compete for subcontracts which utilize weatherization funds. All efforts to utilize small and minority owned businesses shall be recorded and maintained on file.

4. Any information concerning subcontract requirements which Subgrantee personnel share with one prospective contractor or vendor must be shared with all prospective contractors, or vendors to whom the Subgrantee has sent bid or proposal materials.

5. Awards shall be made to the vendor or contractor whose proposal or bid is responsive to the requirements set out in the Invitation to Bid or Request for Proposals and is most advantageous to the recipient, price and other factors considered.

6. All sole source procurements, or where only one bid is received in which the aggregate expenditure is expected to exceed five thousand dollars ($5,000) annually, shall be subject to the Grantee's prior approval.

The Subgrantee shall submit the following to the Grantee with any request for prior approval:

a. an explanation of the reasons for the noncompetitive procurement including the basis for the proposed selection and the price;

b. a copy of the solicitation, request for proposal, or invitation to bid; and

c. a copy of the proposed contract or purchase order for which the Grantee's approval is being sought and any other related procurement documents.

7. All bid and proposal materials must be kept on file and made available for inspection by authorized staff of DOE, EOCD, the Governor, the State Auditor or their agents and shall be retained for three (3) years following expiration or termination of this Agreement as stated in Paragraph 7 (Audit).

B. **ALTERNATIVES FOR WEATHERIZATION MATERIAL PROCUREMENT**

1. Annual purchases up to $5,000 from any single vendor:

a. Telephone price quotation:

(i) The Subgrantee must complete a quarterly telephone price survey for weatherization materials.

(ii) The Subgrantee must receive price quotes from at least three suppliers on a quarterly basis and record them on a survey sheet or card.

(iii) The Subgrantee must make purchases of materials from the most appropriate supplier as listed on the quarterly sheet, or, in the case of a Subgrantee with subdivisions in its service area, from the lowest-rated supplier in a subdivision.

2. Competitive sealed bids without advertising for annual purchases of more than $5,000 and less than $10,000 from any single vendor.

a. The Subgrantee must prepare an Invitation to Bid, which:

(i) Identifies all requirements which prospective bidders must fulfill;

(ii) Identifies all factors which the Subgrantee will consider in evaluating bids;

(iii) Establishes relative weights of all factors, including cost, by means of which the Subgrantee will rank bids; and

(iv) Establishes the maximum amount of the subcontract, its duration, and its geographical scope and states that failure to execute the subcontract will result in bid disqualification.

b. The Invitation to Bid shall include the following provisions:

(i) Any and all bids may be rejected when it is in the interests of the Subgrantee to do so;

(ii) All bids constitute firm offers which may not be withdrawn for a specified period of time from the bid opening;
(iii) The submission of a bid constitutes acceptance of the terms and conditions of the Invitation to Bid, and
(iv) All bids must be sealed and received by the specified Subgrantee contact person prior to a specified time for bid opening at a specified time and location.

c. The Invitation to Bid must be mailed or delivered to no less than five (5) prospective vendors who may reasonably be expected to submit a bid. All vendors who request a bid package must be provided with one.

3. Competitive sealed bids for annual purchases in excess of $10,000 from any single vendor must incorporate the following:

a. All requirements set out in Section B.2. above shall apply without exception.

b. The Subgrantee must publish a newpaper advertisement for three (3) consecutive days in, at a minimum, the newpaper with the greatest circulation in the Subgrantee's service area.

c. This newspaper advertisement shall specify and provide at least the following:

(i) A concise description of the materials or supplies to be procured;
(ii) The Subgrantee contact person from whom prospective bidders may obtain bid materials.
(iii) The deadline for delivery of sealed bids, including the time and place for the bid opening;
(iv) A statement that the advertisement is subject in all respects to the terms and conditions of the Invitation to Bid.

d. The newspaper advertisement shall be published at least three (3) weeks prior to the bid opening to permit prospective bidders to obtain, prepare and submit bids.

4. The following is required documentation when procuring weatherization materials:

a. Documentation of the basis of vendor selection, including the method by which multiple price quotations from varying vendors were compared and evaluated; and

b. Documentation of the basis for the contract award amount, including the estimate for materials which the Subgrantee expects to procure by means of the subcontract.

c. All rating systems must be documented and retained on file.

C. WEATHERIZATION CONTRACTOR PROCUREMENT REQUIREMENTS

1. The Subgrantee must ensure that all participating weatherization contractors are choosen as a result of an open and competitive Request for Proposal (RFP) process. The RFP process must be conducted at least annually without regard to dollar amounts. Weatherization contractors may be procured at any time within the 12-month period immediately following the RFP process.

   a. The Subgrantee must prepare a Request for Proposal which:

      (i) Identifies all requirements which prospective respondents must fulfill;
      (ii) Identifies all factors which the Subgrantee will consider in evaluating proposals;
      (iii) Establishes relative weights of all factors, including cost, by means of which the Subgrantee will rank proposals; and
      (iv) Establishes its duration, its geographical scope, and states that failure to execute the subcontract will result in disqualification.

   b. The Request for Proposals shall include the following provisions:

      (i) Any and all proposals may be rejected when it is in the interests of the Subgrantee to do so;
      (ii) All proposals are subject to negotiations between the Subgrantee and each contractor.
      (iii) The submission of a proposal constitutes acceptance of the terms and conditions of the Request for Proposals; and
      (iv) All proposals must be received by the specified Subgrantee contact person prior to a specified time.

   c. The Subgrantee must publish a newspaper advertisement for three (3) consecutive days in, at a minimum, the newspaper with the greatest circulation in the Subgrantee's service area.

   d. The Request for Proposals must be mailed or delivered to, no less than ten (10) prospective contractors who may reasonably be expected to submit a bid.

   e. The newspaper advertisement shall specify and provide at least the following:

      (i) A concise description of the services to be procured;
      (ii) The Subgrantee contact person from whom prospective respondents may obtain bid materials;
      (iii) The deadline for delivery of proposals; and
      (iv) A statement that the advertisement is subject in all respects to the terms and conditions of the Request for Proposals.

   f. The newspaper advertisement shall be published at least three (3) weeks prior to the bid opening to permit prospective respondents to obtain, prepare and submit proposals.

2. The following is required documentation when procuring weatherization contractors:

   a. Documentation of the basis of contractor selection, including the method by which multiple price quotations from varying contractors were compared and evaluated; and

   b. Documentation of the basis for the contract award amount, including the estimate for services which the Subgrantee expects to procure by means of the subcontract.

3. The Subgrantee may contract for the performance of any portion of a weatherization job, provided that:

   a. The contractor and all employees of the contractor shall have in effect and current all required licenses and certifications;

   b. The contractor shall agree in writing that all materials installed shall comply with DOE standards;

   c. The contractor shall warrant in writing that any defect in materials, manufacture, design or installation of an Energy Conservation Measure found within one year from the date of completion of installation shall be remedied without charge and within a reasonable period of time. (The material warranty is applicable only to contractors who supply material);

   d. The contractor shall demonstrate that it has in effect liability insurance, that at a minimum provides coverage of at least $100,000 for property damage and bodily injury for each occurrence and an aggregate of $300,000 for bodily injury; and

   e. If the contractor has one or more employees, it shall demonstrate that it has in effect workman's compensation insurance issued by a certified insurance carrier.

4. The Subgrantee shall execute an Agreement or contract with each weatherization contractor prior to giving any work orders to the contractor in question.

   a. The Agreement shall incorporate all applicable rules and expenditure limits of the WAP program.

   b. The Agreement shall state the circumstances under which an accepted price for a weatherized measure may be varied in special circumstances and the method whereby the Subgrantee and the contractor will determine the amount of variance.

5. Alternatives for Weatherization Contractor Utilization:

   a. The Subgrantee may solicit proposals on any individual weatherization job, provided at least three (3) contractors are solicited and that those contractors provide a written proposal; or

b. The Subgrantee shall utilize a minimum of three (3) contractors for any individual weatherization measure and apportion work among them on an equitable basis.

6. Procurement of Special Purpose Contractors, Electricians, Plumbers, Roofers, etc:

   a. Proposals:

      (i) The Subgrantee must solicit proposals on any individual weatherization job from at least three (3) contractors.
      (ii) All special purpose contractors must meet or exceed insurance and licensing requirements.

7. Additional Requirements when Utilizing Contractors:

   a. No contractor shall be paid for any work until such time as the Subgrantee has inspected the work and has determined that any such work has been performed.

   b. The cost of materials shall be separated from the cost of installation in billings submitted by the contractor.

WEATHERIZATION ASSISTANCE PROGRAM
CONTRACTOR APPLICATION

DATE _____

CONTRACTOR/COMPANY NAME: _____

CONTRACTOR/COMPANY ADDRESS: _____

TELEPHONE NUMBER: ( ) _____

The following information must be provided to the Subgrantee agency prior to your business performing any weatherization services as part of the Weatherization Assistance Program:

- Copy of appropriate Commonwealth of Massachusetts license or certificate.
- Certificates of Insurance (minimum coverage required) with the Subgrantee listed as certificate holder:
  1. General Liability: Personal Injury: $100,000 per person
     $300,000 per incident
     Property Damage: $100,000 per incident
     Products/Completed Operations Hazard
  2. Workmen's Compensation Insurance

- Please check which of the following program measures your company proposes to perform:
  _____ General Heat Waste
  _____ Insulation
  _____ Heating System
  _____ Storm Windows

The above named contractor/company agrees to the following requirements for all installations of the above indicated program measures.

(a) For those measures which have an applicable DOE material and/or installation standard, comply with such installation standard and install only measures which meet DOE/OEC material standards.
(b) Furnish the Subgrantee agency with a written contract detailing the job to be performed, its cost, and a statement that the installation will be in compliance with all applicable DOE/OEC material and installation standards
(c) Warrant in writing that any defect in materials, manufacture, design or installation of an Energy Conservation Measure found within one year from the date of completion of installation shall be remedied without charge and within a reasonable period of time. (The material warranty is applicable only to contractors who supply material.)
(d) Comply with all applicable Federal, State, and local laws and regulations.
(e) With regard to insulation installers only, assure that at least one installer at each job site has passed the Massachusetts Voluntary Insulation Installer's Exam or substitute workshop. (Provide copy of certificate to Subgrantee agency.)

I hereby certify that I am authorized to sign this Application/Contract on behalf of the Applicant.

Signature: _____

Title: _____

Date Signed: _____

INSTRUCTIONS FOR UTILIZING THE REVISED BWR

SUBGRANTEE: Enter the Subgrantee name.

CLIENT INFORMATION IS MANDATORY: Enter the client's name, street address, apartment number, floor, city, and telephone number.

SAMPLE BUILDING TYPE: Check the sample building type priority list (MA-1, MA-2, MA-3) which was utilized for that dwelling unit. The program operator can elect to evaluate an individual dwelling unit instead of using the state priority ranking of weatherization measures. This will typically occur where the dwelling unit does not fit any of the state building types or where the use of a type's ranking would result in an inappropriate set of measures. The Project Retro-Tech Job Book, revised July, 1979, is designed for use in this situation and the Retro-Tech Job Book box should be checked when this option is utilized.

REWEATHERIZATION: If the dwelling unit has been reweatherized, enter X in "YES" box. If yes, attach a copy of original BWR.

AMEND BWR: When submitting an amended BWR, the subgrantee must insert the original date of submission and enter an X in the box.

EOCD NUMBER: Enter the 3-digit number which EOCD has assigned to your agency. See attached list.

JOB NUMBER: Enter the job number which the subgrantee has assigned to the dwelling unit.

TOWN CODE: Enter the town code which is assigned to the area where the dwelling unit is located. See attached list.

FUNDING SOURCE: Enter X next to the applicable funding source (DOEWAP, MWAP, EXXONWAP, or DOEXXONWAP).

DATE WORK COMPLETED: Enter the final date of job completion. Do not submit a BWR until all work is acceptably completed and post-inspected!

CLIENT INFORMATION

BOX A: Enter X next to the box which describes the status of the dwelling unit's household (owner, renter or income ineligible).

BOX B: Enter the number of elderly persons living in the dwelling unit. Elderly is defined as sixty (60) years old or older.

BOX C: Enter the number of handicapped persons living in the dwelling unit.

BOX D: Enter the number of Native Americans (American Indians) living in the dwelling unit.

BOX E: Enter the total number of persons living in the dwelling unit. Remember that sometimes more that one (1) box must be marked. (Example: A Native American, sixty (60) years of age or older and handicapped, would require an entry in BOX A, BOX B, BOX C, BOX D, and BOX E.)

BUILDING INFORMATION

A. **TYPE OF BUILDING:** Mark an X in the box that describes the building in which the weatherized dwelling unit is located.

B. **FOR BUILDING WITH 2 OR MORE UNITS:**

1. Enter the total # of units in the building.
2. Enter the total # of eligible units WAPPED in the building.
3. Enter the total # ineligible units WAPPED in the building.
4. Enter the Job #s of the other units in the building which were WAPPED. Enter Job #s on the backside of the BWR if necessary.

C. **STATUS OF UNIT:** Mark an X, if applicable, in the box that describes the "category" of the weatherized dwelling unit.

D. **HEATING COSTS:** Enter an X in the box which indicates who pays the space heating costs, owner or tenant.

HEATING SYSTEM

A. **PRIMARY TYPE OF FUEL:** Place an X in the box which identifies the client's primary space heating fuel.

B. **TYPE OF HEATING SYSTEM:** Place an X in the box which identifies the client's primary space heating system.

CONSERVATION IMPROVEMENTS EXISTING

Enter the R-Value, insulation type, and square feet which was installed for each component.

Enter the number of interior and exterior storm windows which were added.

Enter the number of replacement window units which were added.

COSTS

All weatherization and repair material must be itemized consistent with the attachment "BWR SECTION 5 COSTS."

ENERGY CONSERVATION (E.C.) MATERIALS

1. **WEATHERSTRIPPING & CAULKING:** Enter the costs in dollars and cents of these materials.

2. **INSULATION:** Enter the costs in dollars and cents of these materials.

3. **STORM WINDOWS:** Enter the costs in dollars and cents of these materials.

4. **HEATING SYSTEM:** Enter the costs in dollars and cents of these materials.

5. **OTHER MATERIALS:** Enter the costs in dollars and cents of these materials.

6. **E.C. MATERIALS TOTAL:** Add the fugures in number 1-5, and enter the total cost of all energy conservation materials. Total not to exceed $750.

7. **E.C. MATERIALS LABOR:** Enter the cost of contractor labor necessary to install the above stated energy conservation material. Total of 6 and 7 not to exceed $2,000.

8. **REPAIR MATERIAL:** Enter the cost of all materials necessary to protect or supplement energy conservation materials.

9. **CONTRACTOR REPAIR LABOR:** Enter the cost of contractor labor necessary to install the above stated repair material. Total of 8 and 9 not to exceed $500.

10. **GRAND TOTAL:** Add the figures in numbers 1 - 9, and enter the total cost of all energy conservation and repair materials and labor. Grand total not to exceed $2,500.

MAJOR REPAIR FUNDS ACCESSED: If the OEC Major Repair Fund ($501 - $1,000) has been accessed for this job, enter X in the "YES" box.

INKIND CONTRIBUTIONS: Enter the value of the energy conservation materials and labor which was received. Mark an X in the appropriate box which identifies the contribution.

CERTIFICATION: The authorized signature must be that of the Energy Director or WAP Coordinator. When an individual signs an BWR they are stating that all the information provided is correct to the best of their knowledge and that the work indicated has been completed.

SUBGRANTEE COMMENTS: Enter the appropriate comments regarding the dwelling unit or building being reported upon.

EOCD SUBGRANTEE NUMBERS

NUMBER	SUBGRANTEE
501	ABCD
500	ACTION
502	BCAC
506	CAI
049	CAMBRIDGE
508	CAPIC
504	CFC
509	CTI
510	FCAC
511	GLCAC
587	HAC
585	HAP
512	HCAC
513	LEO
593	MENOTOMY
514	MOC
515	NSCAP
516	PACE
517	QCAO
521	SAC
518	SELF-HELP
519	SMOC
601	SOMERVILLE
520	SSCAC
522	TRI-CAP

BWR SECTION 5 COSTS
EFFECTIVE APRIL 1, 1987

All weatherization materials installed in dwelling units must be itemized as listed below:

A. MATERIALS

1. Weatherstripping and Caulking

Door and Window Weatherstripping
Electrical Outlet Gaskets
Caulking Material

2. Insulation

Fiberglass, Blankets and Batts
Cellulose, Vermiculite and Perlite
Rigid Foam Board
Hot Water Heater Insulating Jackets
Pipe and Duct Wrap

3. Storm Windows

Exterior Storm Windows
Interior Storm Windows
Moveable Insulation Systems for Windows

4. Heating System

Combustion Chambers
Replacement Oil Burners
Replacement Gas Power Burners
Clean-Out/Tune-Ups and Evaluations (CTE)
Clock Thermostats
Room Thermostats
Hydronic Boiler Control
Vent Dampers, Gas Systems Only
Thermostatic Radiator Valves
Furnace and Boiler Repairs
Air Ducts and Connectors
Replacement Furnace and Boiler

5. Other Materials

Window Sash
Primary Window Units
Ventilation Devices
Insulation Guards
Vapor Barriers
Replacement Windows
Replacement Doors
Low-Flow Showerheads/Restrictors
Faucet Aerators
Hot Water Pipe Heater Strips
Glazing Compound/Putty
Skirting

8. Repair Material

Glass
Storm Window/Door Repair Parts
Exterior Doorlocks/Parts-Prime Doors
Window Ropes and Locks
Staples
Drop Cloths/Plastic
Glazing Points
Nails
Screws
Brads
Glue/Adhesives
Trashbags
Wire
Sandpaper
Lumber
Parting Beads, Side Stops
Shingles
Flashing
Siding
Masonary Supplies--Bricks, Blocks, Mortar/Cement
Paint/Stain/Sealer, Etc.
Sheet Rock and Similar Material
Repairs Relating to the Primary Heating System Other Than Those Listed Under Category 4
Window and Door Trim
Window Channels
All Other Indirect Supplies

Commonwealth of Massachusetts
Executive Office of Communities and Development
Office of Energy Conservation
100 Cambridge St., Boston, MA 02202

Weatherization Assistance Program

BUILDING WEATHERIZATION REPORT

SUBGRANTEE: _____

CLIENT NAME

STREET ADDRESS **APT. #** **FLOOR**

CITY **ZIP** **PHONE #**

SAMPLE BUILDING TYPE
MA 1 ☐ CONDITIONED BASEMENT
MA 2 ☐ UNCONDITIONED BASEMENT
MA 3 ☐ MOBILE HOME
☐ RETROTECH JOB BOOK

REWEATHERIZATION
☐ YES If yes, attach copy of original BWR.

AMENDED BWR. ☐
Original Submission Date _____

EOCD NUMBER	JOB NO.	TOWN CODE	FUNDING SOURCE	DATE WORK COMPLETED
			1. ☐ DOEWAP 2. ☐ MWAP 3. ☐ EXXONWAP 4. ☐ DOEXXONWAP	MO ☐☐ DAY ☐☐ YR ☐☐

1. CLIENT INFORMATION
A. 1. ☐ OWN 2. ☐ RENT 3. ☐ INCOME INELIGIBLE
B. NO. OF ELDERLY
C. NO. HANDICAPPED
D. NO. NATIVE AMERICANS
E. TOTAL NUMBER IN HOUSEHOLD

2. BUILDING INFORMATION
A. TYPE OF BUILDING
1. ☐ MOBILE HOME
2. ☐ SINGLE FAMILY
3. ☐ TWO FAMILY
4. ☐ THREE FAMILY
5. ☐ MULTI-FAMILY (4 OR MORE)

B. FOR BUILDING WITH 2 OR MORE UNITS
1. # UNITS IN BUILDING ____
2. # ELIGIBLE UNITS WAPPED ____
3. # INELIGIBLE UNITS WAPPED ____
4. JOB #'S OF OTHER UNITS IN BUILDING WAPPED _____, _____, _____, _____

C. STATUS OF UNIT
1. ☐ VACANT
2. ☐ SUBSIDIZED
3. ☐ SHELTER
4. ☐ PUBLIC HOUSING
5. ☐ GROUP HOME
6. ☐ NEW CONSTRUCTION
7. ☐ CDWAP

D. HEATING COSTS PAID BY:
1. ☐ OWNER
2. ☐ TENANT

3. HEATING SYSTEM
A. PRIMARY TYPE OF FUEL
1. ☐ OIL 5. ☐ COAL
2. ☐ NAT. GAS 6. ☐ WOOD
3. ☐ LP GAS 7. ☐ SOLAR
4. ☐ ELECTRIC

B. TYPE OF HEATING SYSTEM
1. ☐ ELECTRIC BASEBOARD 5. ☐ GRAVITY HOT WATER 9. ☐ STEAM
2. ☐ FLOOR HEATER 6. ☐ GRAVITY WARM AIR 10. ☐ STOVE
3. ☐ FORCED HOT WATER 7. ☐ RADIANT
4. ☐ FORCED WARM AIR 8. ☐ SPACE HEATER

4. CONSERVATION IMPROVEMENTS

COMPONENT	EXISTING R VALUE	EXISTING INSUL. TYPE	ADDED R VALUE	ADDED INSUL. TYPE	ADDED SQ. FT. INSTAL.
ATTIC SLOPE					
ATTIC FLAT					
ATTIC KNEEWALL					
ATTIC KNEEWALL FLOOR					
SILLS					
FLOORS					
PERIMETER					
SIDE WALLS					
DUCTS					
PIPES					
STORM WINDOWS	NO.				INTERIOR / EXTERIOR

REPLACEMENT WINDOW UNITS ☐☐

5. COSTS

ENERGY CONSERVATION (E.C.) MATERIALS	
1. Weatherstripping & Caulking	
2. Insulation	
3. Storm Windows	
4. Heating System	
5. Other Materials	
6. E.C. MATERIALS TOTAL	
7. E.C. MATERIALS LABOR	
8. REPAIR MATERIAL	
9. CONTRACTOR REPAIR LABOR	
10. GRAND TOTAL	

MAJOR REPAIR FUNDS ACCESSED ☐ YES

6. IN KIND CONTRIBUTIONS $☐☐☐☐☐
1. ☐ CLIENT
2. ☐ LANDLORD
3. ☐ HEARTWAP
4. ☐ MWAP HTG. SYS.
5. ☐ UTILITIES
6. ☐ REHAB
7. ☐ OTHER _____

7. CERTIFICATION

I CERTIFY that the information provided is correct to the best of my knowledge and that the work indicated has been completed.

_____
AUTHORIZED SIGNATURE

8. SUBGRANTEE COMMENTS:

_____
_____
_____
_____

OEC ONLY
CRT
by _____ date _____

OEC ONLY
CHECK
BY _____

FORM APPROVED
OMB No. 116 46305
MASS. REVISION 4/87 EOCD/OEC